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## THE ENGINEERING COLLEGES AND PUBLIC WELFARE.

Abstracts of Radio Talk Delivered by the President of the Society for the Promotion of Engineering Education, DEAN A. A. POTTER, of Purdue University, from the University of Pittsburgh Studio of KDKA, November 10, 1924.

One hundred years ago the people of this country were concerned mainly with the production of raw materials of grains, cotton, lumber, and minerals. Our few industrial establishments manufactured the coarser things, which were turned into useful articles in the factories of other nations. To-day the United States of America is the greatest manufacturing nation in the world. In our factories each worker has at his disposal twice as much power as any other worker in the world. This enables him to make more goods, earn higher wages and live better than the industrial classes of other lands. In the short space of one hundred years science and engineering have revolutionized the whole environment of our life. Our machine-made products, our methods of signaling and of communication, and our transportation facilities have enabled us to develop a standard of living for all of our people undreamed of a century ago.

This improvement in the standards of our living has gone on simultaneously with a more general appreciation of scientific and engineering education. One hundred years ago, or in 1824, the first engineering college in English-speaking countries in the U. S. A. was started at Troy, New York. This is the Rensselaer Polytechnic Institute, the father of American Engineering Colleges. At the present time the United States of America has 137 engineering colleges which are training about 55,000 students and are graduating annually about 9,000 technically trained engineers.

The principal claim of these engineering colleges has been the preparation of men for the practice of the engineering

profession. These men are trained to have a broad acquaintance with present conditions, an appreciation of the importance of right living, a scientific spirit, capacity for unselfish service to society and an interest in the advancement of the common good. Engineering educators have always been in accord with the statement of Theodore Roosevelt that "to educate a man in mind and not in morals is to educate a menace to society." The engineering student is being constantly impressed with the fact that the stability of society depends upon the character of the people; that capacity to do carries with it a responsibility to society; also that knowledge and talent are of no value to an engineer unless he is trusted and respected by his fellow men. An effort has been made to teach the engineering students only fundamentals; it is to train men who will have the largest development and greatest usefulness in the long run, but not necessarily immediately after graduation from college.

Besides training engineers the engineering colleges of this country have been utilizing their staffs and equipment to solve new problems of value to the public. Engineering educators realize that it is impossible to develop the creative talents of their students unless they are placed in contact with teachers and investigators who are constantly in search of new knowledge. About twenty-five of these engineering colleges have research departments or engineering experiment stations. The publications of these experiment stations include over 500 bulletins which contain valuable new engineering knowledge. Research in the engineering colleges of this country should receive greater encouragement and better support. While the U. S. A. has less than six per cent. of the world's population our men of genius are credited with more than two thirds of the epoch-making inventions during the past century. Our accomplishments in the future will be even greater than those in the past if we pay attention to research and to the development of engineers who can create new knowledge.

Engineering was the first profession to organize a Society

devoted to teaching, the Society for the Promotion of Engineering Education.

(This was followed by the description of the activities of the Society and of the projects now being undertaken under the direction of the Board of Investigation and Coördination.)

Dean Potter closed his talk with the following statement: "The engineering colleges of this country are contributing to public welfare by developing engineers who have the highest ideals of citizenship and who can handle human as well as material problems. They are training citizens who have the ability to think, the capacity to perform useful service to society and the nobility of character to advance the common good of humanity."

# PROFESSIONAL ORGANIZATIONS AND PROFESSIONAL SCHOOLS.

BY

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AND

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In the investigation of engineering education which is now in progress it is necessary to deal with the question as to how largely such education should bear the professional stamp and thus be distinguished from collegiate education of a more general type. An important corollary to this question relates to the part which should be taken by professional organizations of engineers in shaping the program and standards of engineering education, and the responsibility which such organizations should assume for its support and advancement.

An inquiry into the relations which exist between professional organizations and professional schools in other fields of endeavor was considered pertinent and was sponsored by the joint advisory council which has been set up between this Society and a group of the principal national engineering societies. This study led to an effort to define the characteristics of a profession, as distinct from a business, a trade or any other form of vocation. (See Journal of Engineering Education, Sept., 1924, p. 29). It also led to a consideration of the historical background of various professions and of their characteristic educational systems.

## The Nature of a Profession.

Of professions there are many kinds; open professions like music, to which any man may aspire within the limits of his talents, and closed professions like medicine, which may be entered only by a legally prescribed process; individual professions like painting and group professions like law, whose members constitute "the bar," a special class in society; private professions like authorship and public professions like journalism; artistic professions like sculpture and technical professions like surgery. Despite these differences all these callings have certain attributes in common which constitute the professional stamp.

The term "profession" has eulogistic values which are widely coveted. There is an illusion abroad that any vocation may become a profession by the mere willing of it and by serving notice to that effect on the rest of the world. The newspapers of a certain city recently announced that the barbers had elected to be known as chirotonsors in order better to uphold the dignity of their "profession" in the public eye. There is an eager grasping after the form and a total failure to perceive the substance. It is an excellent thing to dignify honorable work and there may be a magic in honorable titles which helps men to live up to them. In the case of the term profession the tendency of the day is to cheapen the term by indiscriminate usage.

Despite this attrition of its meaning, the main outlines are still to be discerned. A profession is something of the nature of a guild limiting its admission and recognition of members by a high standard of competency, accountability and ethical purpose. To be a profession it must deal with problems on an intellectual plane and involving a characteristic science and art. Its members are presumed to be persons of high intelligence who are well instructed in this special science and art and who exercise a high degree of individual responsibility in their work; socially minded and ethically responsible persons who pursue their calling with direct regard to the public good. Otherwise it is simply a vocation.

## What is Professional in Engineering.

There is much in engineering that is professional and some that is not. There are engineers who as individuals meet the strictest tests of professional status. The engineering ranks include many men of doubtful professional status as individuals, who none the less must be counted as constituents of a genuinely professional group. Engineering has traditionally been an open profession, without the protection of legal restrictions. It is a comparatively new profession and its development has shown little of the influence of the mediaeval guilds which is so evident in the history of the traditional "learned" professions of law, medicine and divinity. In the United States, at least, the growth of a corporate consciousness among engineers with the recognition of a distinctive status and obligation as a group in society has been largely confined to the present century.

## Origins of Professional Training.

Many professions have evolved from crafts and professional groups have been built largely on the traditions of the mediaeval guilds. Primitive professional training followed the guild model. The novice learned his craft from the master under a scheme of apprenticeship, in which the masters agreed together to maintain reasonably uniform terms of apprenticeship, advancement was graded, and admission to full standing was based on the acceptance of the candidate by the guild. Apprentices were a source of profit to the master and the number of them was a measure of his prestige.

The mediaeval universities were practically corporate guilds of master scholars. They were divided into four crafts or faculties, philosophy, divinity, law and medicine. Their libraries and lecture rooms were the workshops of scholarship, to which apprentices resorted to master the art. The foundations of professional training in continental Europe embodied the guild ideal, but by this plan of organization were definitely established on a university basis, where they remain almost

wholly to this day. Academic degrees marked the end of the successive stages of apprenticeship of scholars on their way to the full rank of the doctor or teacher. There is no realm where the guild ideal persists more strongly to this day than in the process whereby the university teacher of arts or sciences is trained and in the traditions which surround his work.

The transition from individual apprenticeship to detached professional schools was relatively simple. The fame of certain masters attracted large numbers of apprentices, who became a source of profit and prestige. As groups of apprentices grew in numbers and as the art and science to be mastered grew in complexity and extent so as to require a more arduous preparation, the training of apprentices became a separate function and evolved by degrees into a distinct school. In the light of their origins there was nothing unethical in the fact that such schools were often proprietary. Early universities were no less proprietary, but their titles were in ecclesiastical hands. The evils of proprietary education in more modern times grew out of the abuse of such control for profits under the stress of commercial competition.

### Early Professional Training in America.

Under the primitive conditions of colonial life in America professional training largely reverted to individual apprenticeship. The one marked exception was in the provision for the training of the ministry, which was the chief end sought in the founding of the early American colleges. For the most part the young physician or lawyer went abroad for his training or received it by apprenticeship at home. Professional faculties were show to develop in American colleges. Harvard was founded in 1636, but its medical faculty was not established until 1783. The first professional chair in America was that of medicine at the University of Pennsylvania, established in 1766. A chair of law was established at William and Mary in 1779.

The first American law school to attain a national reputa-

tion was of a private nature, established by Judge Reeve in Litchfield, Connecticut, in 1784. An important precedent in American medical education was set in 1807 by the establishment of a frankly proprietary school in Baltimore under the title of the University of Maryland. Of almost equal significance was the establishment in the same city of the first American dental school in 1840, also an independent institution. The scattered character of the population, the willingness to accept the makeshifts of pioneer life, the laxity of the public regulation of professional services and the slow development of university ideals, as distinct from those of the traditional arts college, tended to fix professional training for law, medicine and later, dentistry in a predominantly proprietary mold, as a natural evolution from individual apprenticeship.

For a long period the operation of such schools proved to be financially profitable. Perfunctory standards of admission to professional practice and the rapid growth of the population left the door wide open to the exploitation of the system for profit on the principles of a competitive business. Standards which were quite honest in their origins but which never had been high on account of the primitive conditions under which they arose suffered inevitable deterioration. The result was a flooding of so-called professional ranks with ill-chosen and ill-trained persons in whose hands the public welfare could not be trusted with confidence. An educational crusade within these professions became inevitable.

### The Crusade for Creditable Standards.

After professional schools of law, medicine and dentistry had taken vigorous root in American universities and had become sufficiently influential to challenge the abuses which had crept into the proprietary system a movement for reform gained headway. The stronger schools in certain fields banded together to appeal to the public and to their respective professional groups for the moral and financial support of a more creditable educational program. Agitation for stricter standards of admission to practice were set in motion. En-

lightened leaders came to the front in professional organizations and appealed for a quickened sense of professional pride and ethical responsibility. The menace to the public and to the professions themselves of an irresponsible scheme of professional training came to be recognized and deplored. The swift advance of knowledge near the end of the nineteenth century served the same end. In medicine particularly, the decay of empiricism and the onsweep of science led to a demand for expensive laboratory and clinical training which the proprietary schools were unable to provide.

At the beginning of the present century the proprietary scheme of professional education had reached and passed its zenith. A series of searching investigations launched by a great educational foundation, a series of vigorous educational crusades within the professional organizations, marked advances in the legal requirements for admission to practice, generous gifts for the support of the strongest schools on a scale unattainable to proprietary ventures, a scurrying to acquire university affiliations by proprietary schools and their consequent amelioration to university standards, the forming of group organizations of the stronger schools for the purpose of elevating and sustaining educational standards, and the working out by these organizations with the related national professional societies of definite procedures for the joint formulation of educational standards, have literally revolutionized educational conditions in law, medicine and dentistry in the last two decades. As in a major surgical operation the situation was acute, the means heroic and the results—while eminently beneficial—have not been attained without a shock to the educational and social organism.

### Control of Educational Standards by Professions.

Guild and apprenticeship origins have given a strong professional stamp to education in law, medicine and dentistry. In all these cases the profession existed first and the educational system was its creature, at all times within its control. Professional control has tended to keep these forms of educa-

tion intensive in method and exclusive in aims. In the United States the evils inherent in the proprietary system have had to be overcome and the status and standards of university education attained, through a somewhat revolutionary process.

The control of the professional bodies over the educational standards in law, medicine and dentistry is now complete. It is exercised in part through the joint agencies of standardization referred to above, in part through a system of rating the schools, and in part through the legal processes which give these professions control over the admissions to their ranks. A very important element in the control of these fields of education resides in the fact that the members of the professional faculties are almost exclusively members of the professional bodies and amenable to them, no less than to educational authorities.

In the field of theological education, especially among the protestant bodies, educational standards have made little progress in twenty years. The system is largely proprietary, in fact if not in form, and university standards are the exception rather than the rule. A critical investigation of the work and standards of the protestant seminaries has recently been made and may serve as a starting point for educational reforms. In this field the control of the educational process by ecclesiastical groups is quite complete and is one of the causes of educational stagnation. There is no effective group organization of the schools and no comprehensive organization of the profession.

The conditions in the field of architecture are of particular interest to engineers because of the close kinship of the two professions. The Association of Collegiate Schools of Architecture bases its conditions of membership on a comprehensive set of educational standards, which have been examined and approved by the Educational Committee of the American Institute of Architects. The Institute designates those schools which are members of the Association as "accredited schools," but has not undertaken to establish educational standards on its own account. Graduates of accredited schools

enjoy special advantages in being eligible to the grade of junior in the Institute on their educational qualifications.

### Background of Engineering Education in America.

The contrasts between the history and relations of professional education in divinity, law, medicine and dentistry and the history and relations of engineering education in America are fairly obvious. Engineering schools are not the offspring of the engineering professions, quite the contrary. The schools came into existence first and helped create the professions. A desire to elevate agriculture and the mechanic arts to the status of professions was given definite expression in the founding of the Rensselaer Polytechnic Institute and in the Morrill Act, to which the great system of land grant colleges owe their origin. The early engineering schools were founded by educators rather than engineers. They grew up as variants to the long established group of colleges of liberal arts, and many of them owe their separate existence as schools within universities to the reluctance of classical educators to admit science and its useful applications to a place of equality in the college system.

### Casual Relations between the Schools and the Profession.

Professional organization among American engineers has followed rather than preceded the development of engineering education. The development of a sense of its corporate existence has been largely confined to the life of the engineering profession in America in the present century. Previous to that time professional organizations among engineers confined their activities almost wholly to the extension of professional knowledge and the interchange of experience in the form of papers and discussions and to the social intercourse of their members. The engineering schools have never sustained a proprietary relation to the professional bodies. While these societies have opened their membership to students in a minor grade, they have not recognized the training given by

the schools as professional in character in the terms of admission to their more advanced grades.

The engineering schools have given the professional bodies no occasions for an educational crusade. The history of the schools is almost wholly free from commercial exploitation and from the shoddy standards incidental thereto. They have made their mistakes honestly and with good intentions, but they have never consciously tolerated abuses which might provoke the professional bodies to intervention. In both the cases where a critical investigation of educational standards and methods has been undertaken it has been on the initiative of the schools and the invitation to participate has gone from them to the professional bodies.

The professional bodies in engineering have never attempted to establish a control over the schools. There have been no joint standardizing agencies, no rating of schools on a scale of prescribed standards, no externally prescribed curricula. They have not attempted to control the schools through their faculties, for members and non-members of these bodies have had equal powers. In fact there is probably no field of education so closely related to professional life as engineering where so large a degree of educational influence has been left in the hands of non-members of the profession. The professional bodies have not attempted to control the schools through guild requirements or legal requirements for admission to professional standing. Such legal enactments as have been established in recent years to regulate the practice of "professional engineering" have left the schools practically untouched.

The above characterization of the present situation is not intended to imply that the relations between the engineering schools and the engineering organizations have been marked by aloofness and neglect. The list of educators who have made notable contributions to these societies is long, as is the list of the educators whom these societies have highly honored. The relations have been eminently cordial and helpful. Educational problems have been discussed by these societies in a

spirit of friendly criticism which has been most wholesome to the schools. The point is that these relations have been wholly casual and not organic.

### Bonds of Free Association Needed.

If the schools are to seek closer affiliations with the professional bodies—and it is worth noting that the present initiative springs from the schools—it may be expected to take the form of a free association and not a proprietary control. It may be expected that the benefits sought and the obligations to be assumed are to be mutual. If the professional bodies are to look to the schools for sounder and broader training of future engineers, the schools may equally look to the societies for clearer definitions of the professional patterns which such training may be expected to follow.

It is equally plain that a closer affiliation between engineering schools and engineering societies can not be an exclusive affiliation comparable to that of the medical schools with the American Medical Association. There is no comprehensive organization of engineers. In addition to a half dozen societies of large membership and national influence there are no less than forty other national organizations to be considered in addition to a great number of local and regional societies, some of which have a great influence. In addition to their affiliations with professional organizations, the engineering schools must maintain equally important affiliations with industry and public service. On the other hand the doors of the professional societies, as in the past, may be expected to open freely to qualified men who are not the products of the schools.

It is one of the objectives of the present investigation of engineering education to indicate how closer bonds, on the principle of free association outlined above, may be developed to mutual advantage between the engineering schools and the organized bodies of the profession. As a background for this division of the study, in order that contrasts as well as parallels may be recognized, facts have been collected concern-

ing educational relations and standards in certain professional fields which are summarized below. An effort has been made to indicate some of the gains, and in a few instances the losses, which have resulted from the concerted efforts toward progress in recent years.

## LAW

*Admission to Profession.*—Lawyers are public officers, admitted to practice by the courts, usually after examination by designated members of the bar, though in some cases graduates of designated schools are admitted without examination. Character requirements are assumed, but not usually formally enforced. No state has established formal educational requirements. Members of the bar are ipso facto members of the profession.

*Professional Organization.*—There is no inclusive organization of the profession. Local bar associations, state bar associations and the American Bar Association are voluntary organizations, somewhat selective in membership. Membership in the national Association is open only to members of the bar of three years standing on recommendation of local associations, where such exist. Election is by ballot. Membership of the national Association in 1923, was 19,871 or less than one sixth of the lawyers in the United States.

*Organization of Schools.*—The Association of American Law Schools was founded on August 21st, 1901. Membership is on an institutional basis and any law school may be elected to membership provided: (1) that it is not operated as a commercial enterprise; (2) that an entrance requirement of one prelegal collegiate year be enforced in addition to a four-year high school training; (3) that a three-year legal course be required for graduation; (4) that its number of special students be limited to ten per cent. of its average total; (5) that it maintain a library of not less than 5,000 volumes; (6) that it have at least three full-time instructors; (7) and that it keep complete individual record of students. The total membership in 1923 was 58 out of 149 law schools in the United States.

*Joint Agency of Professional Organization and Schools.*—There is no joint agency or no definite interlocking of the two associations but rather a certain coördination in that the initial standardization movements are made by the Association of American Law Schools and later usually voluntarily sanctioned by the Section on Legal Education of the American Bar Association.

*Educational Standards.*—The requirements for membership in the Association of American Law Schools have perhaps done more to raise the standards of the profession educationally than anything else. In general the standards of the Association of American Law Schools have tended to be more stringent than those of the American Bar Association. For fifty years or more the American Bar Association has maintained a Committee on Legal Education and Admission to the Bar which has been both a critical and constructive moral force within the profession. It was through the efforts of this Committee that the survey of the legal schools carried on by the Carnegie Corporation for the Advancement of Teaching was made possible. As a result of this investigation the present membership requirements of the American Law Schools were adopted, and sanctioned by the American Bar Association through its Section on Legal Education and Admission to the Bar.

*Evidences of Gain and Loss.*—While the influence of the American Bar Association has been thrown consistently on the side of high educational standards, there is a large group within the profession which supports a so-called "democratic" ideal of easy access to the profession. This division of sentiment tends to perpetuate a large number of low-standard law schools. The standards of the high-grade schools have been greatly advanced by the joint efforts of the two Associations as noted above. Note the accompanying statistical summary.

STATISTICS AND STANDARDS OF AMERICAN LAW SCHOOLS.

| | 1909–10 | 1919–20 | 1922–23 |
|---|---|---|---|
| Number of Schools | 124 | 145 | 149 |
| Affiliations of Schools: | | | |
| Number with universities or colleges— | | | |
| State | 33 | 35 | 36 |
| Municipal | 3 | 3 | 2 |
| Roman Catholic | 9 | 17 | 18 |
| Other | 55 | 54 | 54 |
| Number with other organizations— | | | |
| Correspondence schools | 4 | 1 | 0 |
| Business schools | 1 | 2 | 4 |
| Y. M. C. A. | 2 | 7 | 8 |
| Independent | 17 | 26 | 27 |
| Per cent. with universities and colleges | 81 | 75 | 74 |
| Per cent. with other organizations | 19 | 25 | 26 |
| Entrance Requirements: | | | |
| Number requiring graduation from college | 1 | 2 | 2 |
| Number requiring 3 years of college | 4 | 5 | 6 |
| Number requiring 2 years of college | 3 | 23 | 36 |
| Number requiring 1 year of college | 5 | 20 | 18 |
| Number requiring no college work | 111 | 95 | 87 |
| Per cent. requiring 2 or more years college | 6 | 21 | 29 |
| Per cent. requiring 1 or more years college | 10 | 34 | 35 |
| Per cent. requiring no college work | 90 | 66 | 65 |
| Graduation Requirements: | | | |
| Number requiring 3 years or over | 84 | 126 | 141 |
| Number requiring 2 years | 38 | 18 | 7 |
| Number requiring 1 year | 2 | 1 | 1 |
| Per cent. requiring 3 years or over | 68 | 87 | 95 |
| Per cent. requiring less than 3 years | 32 | 13 | 5 |
| Enrollment | 19,428 | 24,074 | 33,719 |
| Per cent. in full time day schools | | | 44.4 |
| Per cent. in schools requiring more than 2 years college plus 3 years law | 8.6 | 14.2 | 11.8 |
| Per cent. in schools requiring a total of more than 4 academic years | 12.5 | 23.8 | 23.7 |
| Per cent. in schools requiring a total of 4 academic years probably less than | | | 30.0 |

## MEDICINE

*Admission to Profession.*—Admission to the medical profession is by license, issued in each state by a board of medical

examiners and based on examination or its equivalent. Admission is restricted to graduates of medical schools. While medical practice laws have been established to safeguard the public against incompetent or untrained medical practitioners, much confusion and a partial nullification of these laws have resulted from regulations which enable others to obtain licenses to treat the sick without educational qualifications corresponding to those of the medical practice acts.

*Professional Organization.*—The county medical societies form local divisions of the state medical societies and the latter, in turn, form the American Medical Association, the national body. Members in good standing of the constituent associations are therefore members of the American Medical Association, which is representative of the entire profession in the United States, with the exception of relatively few individuals who have chosen to remain outside. The Association maintains a biographical file covering data concerning character, education license, etc., for all physicians in America.

*Organization of Schools.*—In 1923 there were sixty-eight of the eighty medical schools in the United States included as members of the Association of American Medical Schools, which, was organized in 1890. Membership is on an institutional basis, under definite conditions which include an entrance requirement of two years of collegiate work in addition to four years of high school preparation, and a medical curriculum of four years, the units and courses of which are definitely specified.

*Joint Activity of Professional Organization and Schools.*—There is a close, voluntary relationship between the American Medical Association and the medical colleges, both individually and in their group organization. The professional Association, through its Council on Medical Education and Hospitals, is free to fix the terms whereby medical schools are rated, but such terms are established only after conferring with and obtaining the advice of prominent medical educators.

*Educational Standards.*—The Council on Medical Education and Hospitals, established in 1904, seems to have exerted the

most potent influence on the establishment of educational standards. Its work has been greatly accelerated, however, by the investigation of medical education which was conducted by the Carnegie Foundation for the Advancement of Teaching and by the generous financial assistance given to particular high-grade schools by the Rockefeller Foundation.

The Council has established a scale of classification of schools, which is applied on the basis of actual inspection. Schools are rated on a scale of 100 points, on four groups of items, each group being allowed a maximum of 25 points. These groups respectively cover (1) faculty, (2) product, (3) administration and supervision and (4) buildings and equipment in a comprehensive manner. Medical schools obtaining 70 points or above on this scale are rated as "Class A," those obtaining from 50 to 70 points as "Class B," and those obtaining less than 50 points as "Class C." Class A schools are characterized as "acceptable," and Class B schools as "those which, under their present organization, give promise of being made acceptable by general improvements." Class C schools include, among others, those which are privately owned and conducted for profit.

*Evidences of Gain or Loss.*—Through the medium of the plan of classification outlined above and the attendant publicity, the total number of schools has been reduced by about half and the proprietary schools largely eliminated. In the surviving schools there has been notable advancement in resources, equipment, clinical facilities, teaching personnel, entrance requirements and requirements for graduation. These advances have led to a corresponding advance in educational qualifications required by state licensing boards, brought about by the voluntary coöperation of the Federation of State Medical Boards and the National Board of Medical Examiners.

Along with standardization has come a higher degree of specialization in advanced training and in practice. The number of general practitioners has been reduced and in many rural districts a dearth of competent medical service exists. A rise in the cost of medical service due to shrinkage in num-

bers and expensive preparation has been observable. These influences have probably contributed to the growth of "irregular" branches of the healing art, many of which are based on inferior educational standards.

STATISTICS AND STANDARDS OF AMERICAN MEDICAL COLLEGES.

| | 1908 | 1913 | 1923 |
|---|---|---|---|
| Number of Schools | 152 | 106 | 80 |
| Affiliations of Schools: | | | |
| Number with universities | 81 | 75 | 60 |
| Number with colleges | 8 | 6 | 5 |
| Number of independent or proprietary schools | 63 | 25 | 15 |
| Per cent. with universities | 53 | 71 | 75 |
| Per cent. with colleges | 5 | 6 | 5 |
| Per cent. independent or proprietary | 42 | 23 | 19 |
| Entrance Requirements: | | | |
| Number requiring 2 or more years of college | 11 | 32 | 74 |
| Number requiring 1 year of college | 17 | 28 | 0 |
| Number requiring 4 years of high school | 24 | 21 | 6 |
| Number requiring common school education | 100 | 25 | 0 |
| Per cent. requiring 2 or more years of college | 7 | 30 | 92 |
| Per cent. requiring 1 year of college | 11 | 26 | 0 |
| Per cent. requiring 4 years of high school | 16 | 20 | 8 |
| Per cent. requiring common school education | 64 | 24 | 0 |
| Graduation Requirements: | | | |
| Number requiring 4 years (9 months session) | 21 | | |
| Number requiring 4 years (8 to 9 months) | 46 | 94 | 74 |
| Number requiring 4 years (7 to 8 months) | 49 | | |
| Number requiring 4 years (not specified) | 7 | | |
| Number of part time schools | 7 | 10 | 6 |
| Number without specification | 22 | 2 | |
| Per cent. requiring four years | 81 | 89 | 92 |
| Per cent. part time and unspecified | 19 | 11 | 8 |
| Enrollment and Graduates: | | | |
| Matriculants | 22,602 | 17,015 | 17,432 |
| Graduates | 4,741 | 3,981 | 3,120 |

*Note:* The above figures are somewhat approximate, especially those relating to 1908 and 1913 concerning which precise information was not obtainable.

Standardization has apparently fixed the attention of physicians on the physical and medical treatment of disease, with

the result that many persons suffering from psychic and emotional malajustments have sought relief at other hands, and so contributed to the spread of cults of doubtful scientific standing.

## DENTISTRY.

*Admission to Profession.*—Admission to the dental profession is by license, issued in each state by a board of dental examiners, and based on an examination or its equivalent. Admission is restricted to graduates of dental schools.

*Professional Organizations.*—The American Dental Association consists of the members of the contituent state associations and such members of the Army Dental Corps and Navy Dental Corps as may be elected. It is primarily a federal organization. In 1923 it had a membership of 33,451 out of some 55,000 to 60,000 dentists in the United States.

*Organization of Schools.*—The American Association of Dental Schools was founded in 1923 by the amalgamation of the Dental Faculties Association of American Universities, the National Association of Dental Faculties, the Canadian Dental Faculties Association, and the American Institute of Dental Teachers. The present Association is institutional in its membership. Active member institutions are those in the United States which are classed as "A" or "B" by the Dental Educational Council of America, and those in Canada must be acceptable in the Dominion Dental Council. Associate member schools are those which offer one or more years of the dental curriculum, but do not offer a full course for the dental degree. In 1923 the Association had 45 active member schools, out of a total of 46 dental schools, and three associate member schools.

*Joint Agency of Professional Organization and Schools.*—The Dental Educational Council, founded in 1909, is composed of six representatives from the American Association of Dental Schools, six representatives from the American Dental Association and six representatives from the National Association of Dental Examiners. The Dental Educational

Council in coöperation with the Carnegie Foundation for the Advancement of Teaching made a critical survey of dental education in the United States, and in conclusion, promulgated a set of educational standards and a classification of schools which is being made effective through publicity.

*Educational Standards.*—The Dental Educational Council has promulgated a set of standards for dental schools which are exceptionally comprehensive and detailed. In general they prescribe standards of organization and administration on a plan characteristic of the best university practice; a minimum of four full-time, adequately trained, experienced teachers; a minimum ratio of instructors to students; adequate class-room, library, laboratory and clinical facilities; a four-year dental curriculum of at least 4400 hours of actual instruction, the content of which is set forth in detail; a predental requirement of a four-year high school course (to be increased by one year of collegiate work in 1926); and fairly stringent rules as to scholarship, attendance, promotion and graduation. Schools which meet these requirements in full are rated as "Class A." Schools which meet them in large measure and will be able to meet them in full in a reasonable time are rated as "Class B." Schools not acceptable to the Council are rated as "Class C."

*Evidences of Gain and of Loss.*—The consolidation of the four constituent organizations into the American Association of Dental Schools created an inclusive organization which eliminated all causes for reasonable disagreement among the schools except such as are inherent in the real problems of dental education provided opportunity for unprejudiced consideration of methods of teaching and procedures of administration; and improved the relationships between the representatives of the organized schools, and of the organized practitioners and examiners in the Dental Educational Council. The classification and rating of the schools is eliminating the proprietary schools and raising the standards of those of approved affiliations. Since only the graduates of dental schools are admitted to the practice of dentistry, the raising of educa-

tional standards automatically raises the standards of the profession at large.

STATISTICS AND STANDARDS OF AMERICAN DENTAL COLLEGES.

| | 1913 | 1923 |
|---|---|---|
| Number of Schools | 56 | 46* |
| Affiliations of Schools: | | |
| Number with universities | 24 | 32 |
| Number with colleges | 2 | 3 |
| Number of independent or proprietary schools | 30 | 11* |
| Per cent. with universities | 43 | 70 |
| Per cent. with colleges | 4 | 6 |
| Per cent. independent or proprietary | 53 | 24 |
| Entrance Requirements: | | |
| Number requiring 2 years of college | 0 | 1 |
| Number requiring 1 year of college | 0 | 15 |
| Number merely requiring high school graduation | 42 | 30 |
| Number requiring less than high school graduation | 14 | 0 |
| Per cent. requiring 2 years of college | | 2 |
| Per cent. requiring 1 year of college | | 33 |
| Per cent. merely requiring high school graduation | 75 | 65 |
| Per cent. requiring less than high school graduation | 25 | |
| Graduation Requirements: | | |
| Number requiring 3 years | | All |
| Number requiring 3 years | All | |
| Per cent. requiring 4 years | | 100 |
| Per cent. requiring 3 years | 100 | |
| Enrollment and Graduates: | | |
| Matriculants | 6,800 | 13,131 |
| Graduates | 2,102 | 3,415 |

The schedule of subjects in the year of pre-dental collegiate work required by the Dental Educational Council at present.

The Council will not require such a pre-dental year before 1926. Then the required pre-dental subjects will be English (6 semester hours), Chemistry (6 semester hours), Biology or Zoölogy (6 semester hours), and Physics, either secondary or collegiate, equivalent to one secondary school unit.

## ARCHITECTURE.

*Admission to Profession.*—Architecture is legally restricted in a majority of states by a system of licenses to practice,

* Three were discontinued at the end of the academic year 1922–'23.

based on examination, graduation from a recognized school, and practice requirements of from three to ten years. Requirements vary among the states.

*Professional Organization.*—The American Institute of Architects has three grades of membership, viz., fellow, member and junior, graded according to attainments and experience. Admission is open to practising architects, architects engaged in professional education and architectural draftsmen, on proofs of professional capacity and personal integrity. A degree in architecture from a recognized school admits to the rank of junior. The membership in 1923 was 2,810 out of approximately 10,000 persons who call themselves architects.

*Organization of Schools.*—The Association of Collegiate Schools of Architecture was founded in 1912 and is institutional in the basis of membership. Eligibility for membership is based on a requirement of four years high school preparation and an architectural curriculum which meets prescribed minimum requirements in general and professional subjects. In 1923, eighteen out of thirty-eight schools of architecture were members.

*Joint Activities.*—The Association of schools is represented in the Committee on Education of the Institute, and it is the practice to have this Committee represented at the conventions of the Association. The two organizations work together through this reciprocal relation in advancing and maintaining educational standards The Institute does not rate or classify schools, but recognizes the institutions which meet the membership requirements of the Association as "accredited schools," whose graduates are admitted to the grade of junior in the Institute on educational qualifications.

By this arrangement educational standards have been established and are being raised by the Association of schools, but with the formal sanction of the professional Institute. These standards are higher than those usually prescribed by licensing laws and are tending to raise the standards of licensing boards.

*Other Important Agency.*—The Beaux Arts Institute of Design, which offers prizes and displays exhibits for the benefit of the profession, is an important educational influence.

(The statistical data on architectural schools which are available are incomplete.)

## ADDRESS OF WELCOME.

GEORGE NORLIN,

President, University of Colorado.

Mr. President, ladies and gentlemen: This is, I believe, the first national meeting of learned men and women to which the University of Colorado has been privileged to extend its hospitality, and I feel impelled by a very genuine feeling to say that I am extremely happy that the first convention of a national scope to meet upon the campus is that of the Society which you represent.

I have been somewhat puzzled for a long time to try to explain to myself why I have so strong a fellow-feeling for engineers. I am not, as you probably know, an engineer, and I do not even profess to know very much about engineering education. Before I entered that fateful portal over which are inscribed the doleful words, "Leave all peace behind you, ye who become college presidents," I had an ambition to be known as a Greek scholar, but it is only among college presidents that I am looked down upon as a Greek scholar, whereas, among Greek scholars I am looked down upon as a college president. But in any case, the greater part of my academic life has been devoted to researches and to teaching in this field, and therefore I suppose I ought to feel that there stretches between you and me a gulf so wide that we could hardly hear the unpleasant epithets which we are expected to shout at each other across the abyss. And yet I flatter myself that I do not find that there is any division at all—any gap dividing us. I am wondering whether this may be because I am, by first nature, an engineer in spirit, or whether it is because you may be, without being conscious of it, Greeks in spirit.

If I am allowed, even on this hot day, to recall to you a very interesting, although a very difficult dialogue of Plato—

difficult not for engineers, but for ordinary mortals, because of its mathematical computations and speculations; I mean the dialogue which he calls the Timæus, in which the great philosopher tries to present a picture of the creation of this world. There are three elements, as some of you engineers who are also Greeks may remember, in the process. In the first place, there is the element of matter which is conceived as being in the beginning in a state of fluid chaos, utterly rebellious against taking on permanency or perfection form. In the second place, there are the ideals, the perfect patterns or forms, or the "ideas," as Plato calls them, which are conceived mainly as mathematical principles, themselves perfect, but destined never to be perfectly embodied in this world; and then, in the third place, there is what he calls the great master craftsman—the great super-engineer—who, with the blue print of these ideas, proceeds with such materials as he has at hand to build this world of order and form and beauty and utility for human life. Now, this conception which you have in the Timæus of life, whether divine or human, as a creative thing in that sense, as something that is always building a better world for men to live in, is the conception that runs throughout Greek civilization, and it is that which I think more than anything else explains the fact that the Greeks have in many respects laid the foundations upon which we are still building to-day. So that it would not be too great a paradox to say that the Greeks were engineers, and engineers are Greeks. At any rate, I hope you will accept the spirit of that paradox so far as this meeting is concerned.

But the point I really want to emphasize, the point that I am driving at, after all this apparent "beating about the bush," is that the great engineer is often times a greater humanist than the man who has been trained exclusively in the humanities. Indeed, it is a very disconcerting thing to us who are engaged in general education to find often times that students who are trained in humanities alone end up with a blasé attitude toward life and things in general—an attitude which is not humanistic at all, but is fatalistic in its

character; I mean, they end with a feeling that this world has already been built once and for all; it has been rather badly built, but there isn't anything we can do about it; whereas, the real engineer, unless I am mistaken, is one who takes the attitude that the world is always in the process of building, and if it is not as it should be, there is everything to be done about it. Now, this which I call real humanism in the engineer is, I suppose, not brought about by his technical training, but it is something that lies in a certain bent of mind, a certain attitude of his very constitution—what I may call an instinct for construction—which impels him to select the engineering course and to choose an engineering career. And I often wonder whether by connecting up with this kind of humanism, this passion for building a better world, which the engineer has at the very outset—I often wonder, I say, whether by connecting up with that a greater number of sympathetic contacts with the humanistic studies in his education, with the great struggles of the human spirit throughout all the ages, we might not by so doing arrive at almost an ideal product of an educational system, and I am therefore intensely interested in the agitations which are going on to broaden the engineering curricula.

Before I sit down, I want to assure you that we here at the University appreciate more than we can say the friendly honor which you do us in coming so great a distance to hold your convention at this University, and I want to express the hope that you will feel repaid for coming here by the pleasure and the profit which you will have in your experiences upon this Campus, where less than fifty years ago, only the coyotes held their sessions amid the cactus and the sage.

## RESPONSE TO ADDRESS OF WELCOME.

P. F. WALKER,

President of the Society.

As I came across the plains of Kansas and Colorado two days ago, and particularly as I came in sight of the mountains, my feelings rose, higher and higher, and I felt that surely we were doing a good thing to come out here to hold this meeting. I think that it does us good, those of us who work in the lower altitudes, to come out into this mountainous country. To me there is something in the mountains that nothing else can possibly give. For several years I had the pleasure of spending vacations in this general region, and I always come back with the thought and the feeling that I am coming home. Now, I hope that that view, that feeling, is shared in some measure by the membership of this Society; I feel that it is. As I have talked with different ones since we have been here in the last twenty-four hours, I find that many are sharing that feeling. It is on a deliberate plan that this organization moves over the country for its annual meetings, —to the east and then to the west. This is perhaps a long way from eastern centers when measured in miles, but the plan has a great deal of merit. I am sure that those of us who have come from states east, as well as those from the north and south; and the extreme west, have been enjoying the very free and kindly hospitality which has been shown us here; and I want to assure you, President Norlin, and Dean Evans, and the members of the University faculty who have been doing so much and in so effective a manner for our good and our comfort, that we appreciate most heartily the kindness which you have shown us. I believe that we are going away, when the time comes for us to leave, with a feeling that it has been good to be here. I feel that I speak for the entire membership of the Society for the Promotion of Engi-

neering Education when I say that we are pleased and are looking forward for a series of most helpful and strengthening sessions. At times in our deliberations, in our planning, in our studies of problems of education where there is reason for giving most earnest thought, here, perhaps, among the high places we may carry out some of this thinking and planning on a scale that will bring the desired results; and so again I thank you, President Norlin, for your kind words and for the generous hospitality which the members of your staff as well as yourself, have extended to us.

## ADDRESS OF WELCOME.

VICTOR C. ALDERSON, President,
Colorado School of Mines.

We are very glad and appreciate the courtesy of your coming here and meeting with us. When you come to Golden it is well to realize that this is one of the oldest towns in Colorado. If a careful search is made it will be found that Golden is the most historic spot in Colorado. It is not generally known, but it is a historical fact, that the town was settled by a group of gold seekers from Boston, Massachusetts; that down on the banks of Clear Creek they hung a man simply because they didn't like him. He had not committed any particular crime, but they just did not like him, did not like his appearance; so that they just hung him. It is well known, of course, that the first gold seekers in Colorado found gold lower down on Clear Creek, and followed the creek up to Golden and then went into the mountains. The first gold-bearing quartz ledge was discovered at Idaho Springs. As a matter of comparison, it is singular that this happened seventy years ago, and yet within the last two weeks, within half a mile of where Jackson first found his gold-bearing ledge another strike has been made, as we say out here, and a very high grade gold ore has been discovered. That is, within a half mile of where gold was first discovered, we have discovered it a second time. I visited the mine a few days ago and found it a very important and interesting discovery. The ore carries gold to the value of several thousand dollars a ton; a three foot seam averages fifteen dollars a ton.

The Colorado School of Mines is an individualistic, high-grade, technical school, and has all the troubles and all the joys that come from that kind of a school. If there is one feature about the school that over-shadows everything else it is our thorough belief in the principle that the real substan-

tial part of an engineering education is a thorough knowledge of the fundamentals. It is almost a creed with us. We believe in it thoroughly. I have seen it illustrated so many times, in students who have gone out, that if they are well grounded in the fundamentals, they will succeed. Without the fundamentals, advancement is unlikely.

We are interested in engineering; not in those things that grow in the ground, but the things that were deposited in the ground and do not grow. In other words, we are interested in mining in any phase in which the subject comes. We cling to that idea and are not departing from it, even though we are influenced, time and time again, to get away from it. We feel that if we can maintain a high-grade mining school, we have done our part. The particular features of mining in which the school is now interested are metal mining, metallurgy, geological engineering, and petroleum engineering. We are doing our best to cover the field well. If a man wants to study civil engineering we tell him to go where they have a good civil engineering course; if he wants to study mining engineering, we advise him to come to Golden.

I thank you, gentlemen, for coming here. I hope your visit will be pleasant. After the meeting this afternoon, I trust you will all go down to the experimental plant, because that is the best thing we have to show. We have other things, but that is by far the best and will interest you more than anything else. Professor Warren will talk about it, so I will say nothing, because that would be "stealing his thunder." There is nothing like our Experimental Plant in the United States. There is the equivalent in London at the Royal School of Mines, and before the war they had the equivalent at Magdeburg-Bruckau, in Germany, but nowhere else in this country can you find the counterpart of our experimental plant—I hope you will visit it.

## THE EXPERIMENTAL ORE DRESSING AND METALLURGICAL PLANT OF THE COLORADO SCHOOL OF MINES.

BY PROFESSOR S. POWER WARREN.

When it comes to talking about this experimental plant, I would just as soon talk about that as I would about what I like to eat. In other words, I feel as though I were a part of that experimental plant. We have done so much in the last six months to get the good will of the people of Colorado in general that we feel like we were passing out $10 gold pieces, or something like that, when we go around in the mining community.

I am not going to take much time to tell what machines we have, in detail, because I expect to have you down there after we get through; but I will say this: We have a complete sampling unit that will handle carload lots; and, of course, we have all the small laboratory equipment. We have a unit which includes a four by four ball mill, a concentrating table, and a flotation machine. We have another unit which includes a three by six rod mill, a table, and another type of flotation machine. These two units are so arranged that we can pump the feed from one to another; we can combine both the rod and the ball mill grinding, and we can combine any class of tabling, including classification; and we have, as I say, two types of flotation machines.

The test work that is done is divided more or less in sections, in this way: We insist that a preliminary test be done on an ore, and we drive home as forcefully as possible to the man sending the samples that we are giving him results on the sack of ore we receive at Golden. If those results are going to mean anything to him, that sack of ore has to mean something to his mine. In other words, we are not reporting on

his mine; we are reporting on the sack of ore that we receive from his mine. The cost of that preliminary work is simply the cost of assaying. We tell a man that if he wants to designate some assayer in Denver to take our pulps, we would prefer that he do so, because we have an assayer down here who is so crowded with work that any relief we can get is worth while. We make a charge on this assay of sixty cents a determination. Now, some men say to me, "How in the world can you run a gold or a silver for sixty cents?" I say, "We cannot, but we can run an insoluble for about ten cents, and so between the two, we figure that a flat charge of sixty cents, irrespective of whether it is gold, zinc, lead, or iron, is fair. We obtained that figure from the local assayers in Denver. That is what they charge on test work. Understand, that refers to the test work only. If a man comes in with a hand sample, just a specimen sample, he is charged just about one hundred per cent. more than he could get it done for at his local assayer, and we tell him so. Numerous men come up here with samples, and we tell them what we think it is, and show them where it is going to cost them $1.75 to run a gold, and they naturally go back to their local assayer. In other words, the State is not running in competition with the assayer who is making his living in that line of work.

We have a small unit, including a two-foot Hardinge mill, an eight-cell flotation machine, two mechanical classifiers and two concentrating tables, which we assume will handle in the neighborhood of two hundred pounds an hour. The function of this unit is this: An engineer goes out to sample a mine, and if he is an efficient engineer—and those are the only kind with whom we want to deal—he will take large original samples, cut out his assay samples and save the rejects. These rejects he can send to Golden and can make a six or eight hour run on this two hundred pound hour unit, which will give him a good idea of what can be done on the ore from the particular mine he is sampling. Then the two larger units that I mentioned will each handle twenty-five tons in eight hours. They are arranged to do work after we have done the preliminary

test work, and after we have run a small test on the two hundred pound unit. In other words, we want to get everything lined up, because we cannot afford to make mistakes; you all appreciate that. No matter what the school is, or what the place is, the man at the school is supposed to know everything, and I think that we here are the ones that appreciate how little we really know, whereas the outsider thinks we know a whole lot. So we cannot afford to slip up there.

I might say that the personnel of the plant includes Mr. A. J. Weinig, as director, and I am fortunate enough to be his associate director. I think the reason why they got Weinig and me together is that Weinig does the things and I talk about them. Weinig is sitting over there now; he is smiling, and he appreciates that that is true. He does the things, and I go out and talk about them; but nothing will get you anywhere in this world unless you coöperate, and that is the way Weinig and I coöperate.

In the past there have been a number of things started at the plant. For instance, Professor Coalbaugh here, although he did not get his original idea at the plant, did a lot of work. I remember watching an eight-hour run on a little bit of a furnace that he made; I imagine it took him about three months to make it, and about eight hours to make the test. Is that right, Professor Coalbaugh?

**Professor Coalbaugh:** A little longer than that.

**Professor Warren:** It takes you three or four months to get ready for a test, and then it is all over before you realize you have finished. Then, the Gordon process, the ammonia leach was worked out quite successfully at the plant. This is another scheme for the complex ores. These two schemes the Coalbaugh and the Gordon have gone ahead to a certain extent. Professor Coalbaugh, I think, is a little ahead of Mr. Gordon, but Mr. Gordon is liable to catch up with him. Mr. Ginet, of the Monarch Oil Shale Company, had a large size retort operating at the plant in which he worked out numerous mechanical details in the retorting of oil shale. I re-

member some year ago there was a big test on the treating of manganiferous silver ores from the isle of Sumatra. The reason why I am bringing up these things that were done before Mr. Weinig and I started is because we have done so much since that we want to have the other fellow get a little credit. The main thing we have done, however, is to finish up the scheme that Mr. Weinig started for the determination of oxygen in cyanide mill circuits. Those of you who are familiar with the cyanide game, and wonder why your solutions won't precipitate, and wonder why they won't dissolve, know that the oxygen content of your solution has a very important part to play, and you also know if you try the gasometric analysis of the oxygen in those solutions, you would probably get two or three out in a day. Mr. Weinig has devised a scheme, and it was presented in the paper before the A. I. M. M. E., April, 1916, in which you can run oxygen content in a solution in ten minutes. It has been used at the Golden Cycle Mill by Mr. Bloomfield, and he writes telling us that it is a mere detail of his routine work. In fact, he says the first two or three weeks the scheme was put in practice the operators went around the mill testing the solution in every available place. That speaks for the simplicity of the scheme. We have let this determination help us in the cyanidation of concentrates. We find that the different sulphides deplete the solution of oxygen very quickly, and we are able to determine this rate by this particular method for the determination of oxygen.

Along the flotation line, an interesting condition came up in which the bigger companies were using a flotation reagent which Mineral Separation has patented. In fact, they will sell you Z–1, Z–2, Z–3, Z–4, and Z–5. It is all the same material, but in a different form. We were fortunate enough to get some, and it worked such wonders that we wanted more. We wrote for more, but they did not have it; however, they made the proposition to Mr. Weinig that if he could find out how to make it, he could make all he wanted and use it all he wanted. We are making Z now, and if any of you want a

little sample of the best flotation agent so far found, we will give you some made at the Colorado School of Mines. In this connection we have devised in our short stay here a lead, zinc, iron separation by flotation. I think you men will appreciate when I tell you that this scheme, when worked out, was given to the students and it worked; we gave it to them no matter what ore they had. In order to eliminate the personal element that would be injected into it by Mr. Weinig or myself. we sat down and outlined the thing for the students, and as I say, it worked. We have done it at innumerable places. Trips have been taken by Mr. Weinig and myself out into the field, and speaking for myself, in one instance I simply sat down in the laboratory with the chemist of this particular company and outlined to him how to make this separation. If I can remember the figures correctly, he made a 74 lead with practically eighty per cent. recovery, and a 54 zinc with eighty-four per cent. recovery out of complex ore. The man was astounded, because his particular mine for some ten years had been running with a total loss of slime, because they could make their zinc iron separation only magnetical. This has been done in several places, and it is very interesting to have a man telephone from Denver and say, "We have a zinc lead iron ore, can you float it?" We usually get a firm grip on the desk and say, "Certainly, bring it out." The man will come out the next day and we will put his ore in the ball mill and grind it up, then put it into a flotation machine. We admit we are as careful as possible but, we have not missed yet floating a new ore. If any of you men want the details of this, I will be pleased to give them to you.

We have some interesting things come to us from the camps, and it is along this line where we think we will be helpful. For instance, a man came to me the other day, an Easterner. He had been putting some money in a mine, and they had evidently in their cross cut tunnel found the streak, some two hundred ounce silver ore, four feet wide. He came rushing down, and said, "I want you to arrange to build a mill right away." I said, "Fine; how much of this ore have you?"

"Well," he said, "four feet wide where we struck it, and we have drifted on it twenty feet." I took a pencil and paper, and pulled an old envelope out of my pocket and I said, "The vein is four feet wide. What size mill do you want?" "Oh, just a fifty ton mill will be all right." I figured out fifty tons for thirty days, a month; I figured out a four foot streak, and showed him where he would need a block of ground practically fifty feet long and one hundred feet high, to furnish his mill with ore for thirty days. Well, it would certainly have amused you to see him pick up this piece of paper, put it down and pick it up again and say, "Is that right?" and then fold it up and put it in his pocket. Then, we have other amusing instances. A man came to me sometime ago—and, by the way, we really have a visitor or two a day, with some ideas—but this man came to me and told me he had an ore up near Alma, gold ore, running about sixteen or seventeen dollars, and he wanted to know how to treat it. "Will it cyanide?" We said, "Why, sure it will cyanide"; and he reached down in his pocket and pulled out some tests that were run by Bloomfield, of the Golden Cycle—and there is nobody in the country who can run them better—I read it over and saw where he had been getting better than ninety per cent. recovery in 72 hour agitation. I said, "What is the matter, why come to us? You have these tests, and when you have results as good as that, why come to us?" "Well, Mr. Warren I will tell you; I met a man down in Denver who tells me he has a machine that he can roast this ore, and he can get more than my $17 out of it." I said, "Do you believe that?" He said, "I can't help believe it." He says: "That man takes some of my ore and puts it in his machine, and it comes out running $50 a ton." Well, the upshot of thing was that that man wanted me to go down and investigate this process. I said to him, "Do you really believe that there is any scheme that will put metal into this ore?" "Why, no," he said, "But it is there, and the assay won't get it." I just turned that man around, and I said, "Now, here, you are absolutely an insult to the mining profession; there

is the door, now get out." But that is just one of the little things that come to us that I want to mention.

Now, we have gone into helping out mining companies by actually doing the designing and advising during the construction of their mills. We have a drafting room at the plant, and have designed a mill for the United States Vanadium Company at Rifle. We are finishing the test work on a couple of other mills, the design of which will be carried on at the experimental plant. There are innumerable other things to talk about; but, what is that old saying, "The tongue that is hung in an empty head talks the loudest," so I would prefer to stop here, and as soon as this meeting is over, you gentlemen will adjourn to the plant and see what we have there, we will be glad to have you; and one thing I want to insist on, if you have any suggestions, give them to us, because our plant is full of things that were suggested by the other fellow.

DISCUSSION.

**C. H. Fulton:** Professor Warren told some interesting stories about the procedure. I can tell one, from real life, too. In South Dakota, the School of Mines at Rapid City has been in existence for many years. I went there about 1900, when this section was still great Indian country. Just a few miles southwest is the Pine Ridge Reservation, and occasionally the Sioux get the prospecting fever and come to the Hills. One day two bucks brought in a sample—this did not happen to me, but to a friend of mine—and wanted to know whether it could be assayed. It developed later that they did not quite know what "assay" meant; but that is what they said. So this friend of mine said, "Yes, this can be assayed, come around tomorrow and we will give you the results." He had the rock assayed, with the usual result, by the standard procedure which dampens the enthusiasm mentioned by Professor Warren, that you cannot get it all out by the fire assay, and handed them the certificate of assay. The bucks looked skeptical and said they didn't want any paper, they did not

want a certificate. What did they want? Well, they wanted the gold. "But" said my friend, "there wasn't any gold in that rock and any way it was a little piece"; but they could not see it. So they came back the next day and brought two more bucks along, and soon they brought some of the squaws, and they camped in front of his house, about fifteen or twenty Indians, for a week before he could get rid of them. If you ever face an occasion of this kind, find out first if your clients know or understand what you mean by "assay." These Indians thought they were going to get enough gold to last the rest of their days.

**P. F. Walker:** I wish the opportunity to say just a few words, not with reference to the particular topics that you have been discussing, although they have been intensely interesting to me; but perhaps more with reference to the plans and program for the next three days.

Let me say before getting away from the topics of this gathering, that I am much interested to note the processes and methods which several of you appear to be using in your teaching. I believe intensely in the problem method. I should say, perhaps, that I believe in it intensely where it is possible; but following that, I want to say that I believe it is possible in a great many more cases, and under many more conditions, than many are inclined to believe. I was interested to note from Professor Forbes' paper the emphasis given to the actual development of the situation, so that the student, as he is working, comes to the point where he will realize and begin to appreciate the operating procedure.

I want to say that it is a matter of great gratification to me to note the success of this meeting, and the large attendance this afternoon. The discussion which led up to it began last Fall, when there came to my mind, as there came to others, the thought that this meeting out here in a mining state would be a most fitting occasion for the Society to give greater emphasis and special attention to the mining educational phases of our work. So this thing has been coming along through the year by correspondence. I am very much

pleased, and I hope Doctor Fulton is, also. I hope that he feels the same gratification over the success of this meeting, and the number of people in attendance. It augurs well for attendance at the other sessions this week; and it is a very satisfactory outcome for this experiment of the holding of these group meetings, meetings for men who are interested in a certain line. You all understand it is a committee matter. The program was developed by two of our committees, the committee on Mining and the committee on Metallurgy, and I see no reason why other groups should not at their meetings during the coming years take the opportunity to bring together the men who are particularly interested in the lines represented by the committees for this sort of conference.

As you all know, I presume, the sessions start tomorrow morning at Boulder, and the first session will be given over very largely to a discussion of mining matters. We have arranged the program with mining topics coming early, because the civil engineering meeting on the Pacific Coast, and the electrical engineering meeting in Chicago have been in session, and some who will come to this meeting probably will not get here until to-morrow afternoon, or possibly Friday morning; so let me say to all of you, who are perhaps local men,—I don't know many of you personally,—come if you can to the meeting to-morrow. The invitation is extended to you personally and individually to attend the sessions.

# MINING ENGINEERING EDUCATION SINCE 1910.*

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Three noteworthy things have exerted a more or less pronounced influence upon mining engineering education since 1910, namely, (1) the World War, (2) the Mann Report,† and (3) the conference on commercial training for engineers fostered by the U. S. Bureau of Education, which was held in Washington in June, 1919.

All engineering courses have, of course, been affected by the three things just mentioned, but mining engineering curricula are in general so crowded and inflexible that they are particularly difficult to modify, and the fact that they have been changed is proof of the compelling force of the factors mentioned. It is but fair to admit, however, that some significant modifications cannot be attributed to these three causes, but are, instead, to be regarded as natural developments arising from the sincere desire of educators to improve courses and to meet better the needs of the mineral industries.

The three outstanding things that have affected engineering education will be considered briefly in the order mentioned:

The war first threatened to leave the mining schools without students and minus many of their most capable teachers;

* The percentages given and most of the facts and opinions herewith expressed were obtained by means of a questionnaire sent to the more prominent mining engineering educators of the country. Thirty-four replies were received, and it is believed that the data thus obtained are sufficiently numerous and reliable to make it possible to generalize with confidence.

† Charles Riborg Mann, "A Study of Engineering Education," the Carnegie Foundation for the Advancement of Science, Bulletin No. 11, 1918.

then brought about a hectic few months during which cherished traditions were thrown in the scrap heap and methods intended solely to meet the needs of a great nation at war were substituted therefore.

With the very welcome, but unexpectedly early, cessation of hostilities many educators returned with relief and thanksgiving to long established customs, but found it impossible entirely to escape serious condition of the educational problems arising from the conflict. Engineering was never so well advertised, its value and fundamental importance to human happiness were never so strongly demonstrated, its possibilities and opportunities were never so plainly shown as by the "Engineers' War"; and thousands of young men who otherwise might never have thought of studying engineering resolved to equip themselves for the practice of that profession. Their ranks were swelled through the rehabilitation work of the Government, and many engineering colleges found it extremely difficult to care adequately for their suddenly augumented classes.

The relatively low prices at which metals were quoted, and the resulting slump in the mineral industries tended to decrease the number who might otherwise have chosen to study mining engineering; nevertheless nearly all the better mining colleges reported increases in registration which were in some instances so great as to tax severely the resources of such schools. Then, too, for several years the students were effected by a strange restlessness, an apparent inability to concentrate upon serious study, and an intolerance of discipline and long established modes of doing things that proved decidedly perylexing and trying. Fortunately these conditions, the natural consequences of a catastrophe that threatened to obliterate our civilization, no longer prevail; but they form an ineradicable feature of the decade.

Numerically, the direct effect of the war is shown by the fact that the total registration in mining in 1915 was approximately fifty-five per cent. of what it was in 1910. However, the total enrollment in 1922 was about one hundred

and five per cent. greater than in 1915, and fifteen per cent. greater than in 1910. From the standpoint of enrollment, then, the mining schools barely held their own during the decade following 1910, although the curve was ascending very rapidly in 1920.

Although the average increase from 1910 to 1922 was only fifteen per cent. several institutions experienced much higher increases, in some instances amounting to one hundred per cent., or more. Of course, these schools were the ones that found the period following the war a rather severe strain upon their resources. To counterbalance the growth of such institutions and keep the average increase only fifteen per cent., it is found that thirty per cent. of the mining schools actually had smaller registrations in 1922 than in 1910, and that ten per cent. actually had fewer students in 1922 than in 1915.

The second of the notable features of the decade, Dr. Mann's report, is filled with extremely interesting data and suggestions which deserve and have generally received the careful consideration of engineering educators.

Dr. Mann urged among other things, however, that (*a*) curricula should be constructed in such a way that the number of required credit hours per week should be less than eighteen—preferably sixteen, (*b*) that the number of simultaneous courses carried should not be more than four or five at the outside, (*c*) that all engineering curricula should be identical through (by inference) at least two years, (*d*) that "practical" courses should be introduced as early as the freshman year and a determined effort made more closely to link theory and practice, and (*e*) that "considerable attention should be paid to humanistic studies like English, economics, sociology, and history" and that the study of English be planned so as to develop skill in expression, appreciation of literature, and a philosophy of values and cost, such a course to cover "several years."

Mining engineering educators have generally found them-

selves unable to harmonize all or even most of these suggestions with the necessarily varied and extremely comprehensive four-year course that they feel obligated to offer. Indeed, it is doubtful if Dr. Mann would have made such recommendations if he had studied especially the problems of the mining schools and had attempted to formulate solutions therefor. Some of his ideas have been or are being adopted, however; and his report has certainly awakened mining engineering educators to the desirability of modifying curricula, courses, and practices to meet present-day conditions.

The third especially noteworthy agency mentioned, the conference on commercial training for engineers, had a profound effect upon engineering curricula. At least one third of the mining courses were thereafter modified by the addition of a greater or lesser amount or required work in economics, accounting, business administration, etc.; and another large proportion of such curricula were so changed as to admit of the election of work in such subjects. Probably never has so sweeping a change been made in as brief a time. It is true that comparatively few schools offering four-year courses in mining require the full minimum of twelve hours of commercial subjects recommended by the Committee that collaborated with the Commissioner of Education in calling and planning for the Conference, but deficiencies are doubtless attributable to the terribly crowded conditions of mining curricula. It is really surprising that as much has been done along this line without lengthening courses, at least in most instances; and it would make an interesting study to ascertain whether so-called "fundamentals" or "specialized subjects" were curtailed in order to introduce the new material.

That more mining curricula were not modified by the introduction of required commercial work is doubtless partially due to the facts that some of them already demanded some study along this line, and several faculties doubtless tried sincerely, but unsuccessfully, to introduce such courses. It is true, however, that a few mining educators are still uncon-

vinced that the change is necessary or even desirable. They argue that it is not the province of an engineering school to graduate executives from a four-year course—that training for such positions should be left to a fifth or sixth year and made optional to men especially qualified by ability and inclination to pursue it. They take comfort from the knowledge that practically all the great mining executives of the present day had no formal training in such subjects while in college, and express the belief that men qualified to serve as administrators will train themselves for the work after graduation. Time alone will show whether they are right or wrong, but it is certainly a fact that practically all engineering courses have had more economics incorporated into them since the Washington conference even though formal courses in commercial subjects may not be required. While some institutions have been only slightly influenced by the Washington conference, a number of leading mining schools have swung far to the other extreme, and now offer commercial options or distinct curricula leading to degrees in administration engineering; they frankly admit that it is their hope to train administrators rather than technicians. This admission is characteristic of schools that have courses extending over more than four years.

Besides the general introduction of commercial subjects, outstanding curriculum changes made since 1910 include the addition of more required English, and a continuation of the drift away from foreign language work. Since 1910 more English has been required in about 25 per cent. of the mining curricula, and 10 per cent. of the schools offering such courses have dropped foreign languages as a required study. So far as is known, no such school has added foreign languages to its requirements during this period.

A number of new subjects first attracted attention or were greatly developed during the decade following 1910. A list of such subjects would include the microscope study of opaque minerals, metallography, ceramics, oil flotation, electro-metal-

lurgy, the application of electricity to mining, the standardization of mining methods and equipment, and petroleum geology. Several of these topics have been incorporated as required work into most mining courses, and the remainder are offered as electives. In a number of instances, petroleum geology has been elevated to the dignity of an optional course that leads to a specific degree. This action has been taken in response to a demand that arose as a result of the oil boom of a few years ago. It is, however, undoubtedly true that so much attention was in this way attracted to geology that it has become difficult to find satisfactory employment for the over supply of "geologists" now graduating.

An extremely interesting and important feature of the decade was the lengthening by at least two schools of the course of study considered necessary for the theoretical training of a mining engineer. These schools seek to place mining engineering education on the same plane as that required for the practice of law or medicine, by requiring three or four years of general college work, followed by three or two years of professional study. It is noteworthy that in the two institutions that have adopted this plan the enrollment is now less than 25 per cent. of what it was in 1910 when four-year courses were offered. In fact, the actual enrollment in these schools is so small that a decidedly specialized engineering course which demands the use of expensive equipment and the employment of well paid instructors can only be given at a very high cost per student. Possibly, however, the research work done or directed by the faculties of these schools is a sufficient justification for the continuation of their present plan of operation.

Even more significant than the actual lengthening of the curricula in two institutions is the opinion expressed by 25 per cent. of the deans or professors of mining engineering in other schools that the prevailing four-year course should be extended over one or two additional years. Several other executives are far from satisfied that four is long enough. In sev-

eral instances the tendency to lengthen the period of preparation is shown by definite catalog recommendations that graduates of the four-year course in mining engineering should continue their study for one or two additional years. Of course such lengthened courses lead to advanced degrees.

Since a material decrease in the enrollment must inevitably follow lengthening of curricula as long as there exist good schools granting a mining degree after a four-year course, it is unlikely that many such courses will be lengthened in the near future, although several mining colleges seem about ready to take that step. That the majority of such institutions will cling to the four-year course for some time to come is indicated, however, by the fact that 40 per cent. of the men in charge of mining engineering courses believe that the work now offered is satisfactorily meeting the needs of the mineral industries, and 15 per cent. more are fairly well satisfied with present conditions.

It has frequently been suggested that too many young men are being encouraged to study mining engineering, and that the mineral industries cannot properly absorb the product of the many mining schools. In this connection it is interesting to note that 30 per cent. of the mining educators (most of them are situated in the west) believe that the number of students studying mining engineering should be increased, while 15 per cent. (practically all of them are located in the far east) think that it should be diminished. The remainder believe that it is about right now, should be increased "when normal conditions again prevail," or express the opinions that "there is lots of room for the broadly trained mining engineer—perhaps in other industries," "the quantity should be a secondary consideration," "the students should be more carefully selected," etc.

Many mining schools have made material improvements in plant and equipment since 1910. In fact 60 per cent. of the institutions offering mining courses report that advances of this kind have been made, and it is evident that the average

student of mining engineering is now working under much better conditions than formerly prevailed. Even more gratifying is the expressed belief that 60 per cent. of the mining courses are adequately supported and equipped, or approximately so.

Investigation shows that there is still much diversity in the degrees conferred on completion of a four-year mining course, but about 30 per cent. of such courses lead to the title of Bachelor of Science in Mining Engineering, and 15 per cent. more terminate in degrees that are only slightly different, such as Bachelor of Science in Mining, Bachelor of Science in Mining and Metallurgy, etc. 25 per cent. of the mining courses lead to the degree of Bachelor of Science without modifying phrase, while only 15 per cent. of the mining schools give the degree of Engineer of Mines on the completion of a four-year course. At least three institutions that conferred the degree of Engineer of Mines after a four-year course in 1910 now give the Bachelor's degree, and at least one school does not confer the degree of Bachelor of Science in Mining Engineering until the completion of a five-year course. The general and growing practice is, then, to grant some form of Bachelor's degree after four years, and to consider the degree of Engineer of Mines a professional title to be earned only after the completion of one or more years of graduate work.

One of the most gratifying developments of the decade is the increased attention that is being given to research work. Eighty-five per cent. of the mining educators report material improvement in this particular and the remainder have always emphasized research as much as possible. To some extent this change may be attributed to the U. S. Bureau of Mines Experiment Stations or Field Offices established in about a dozen institutions since 1910, but the real explanation is doubtless found in the fact that engineering educators now have a different conception of their task from that formerly held. At first, trade or industrial school ideals prevailed to a greater

or lesser extent even in institutions that claimed collegiate status, and engineering graduates rarely expected or secured a standing better than that of high grade artisans. With the transition of engineering from a vocation to a profession it has been generally recognized that engineers are obligated to render service by contributing to human knowledge in accordance with professional standards, and good engineering schools are now definitely committed to extensive research programs with a consequent revivification of the technical courses and material benefit to the industries concerned.

The fact that the mineral industries are benefitting from research carried on in mining schools is only one indication of the tendency shown for such industries and schools to draw together and to coöperate more closely than in the past. This movement toward coöperation has taken various forms, such as the establishment of research scholarships or fellowships by several great corporations, the formation of experiment stations or bureaus mainly designed to solve technical problems encountered by the industries, and the perfection of arrangements that give mining students an opportunity to gain a variety of practical experience during vacation periods. So far has this movement gone that the students of one mining school who choose to do so may work two shifts each week (Friday and Saturday nights) in productive mines.

From what has been said, it must be evident that mining engineering education in the United States made material advances in the last decade, and the conditions under which it is now carried on may be regarded as generally good. The willingness of the educators to modify their curricula to meet changing conditions and recognized needs has been demonstrated, and the fact that many of them still differ as regards questions of considerable importance may be accepted as an indication of further improvements yet to come. Opposed to this satisfying outlook, however, there are a number of disquieting facts which may be briefly summarized as follows:

1. 40 per cent. of the mining schools are inadequately

supported and equipped, and several of them are badly overcrowded. In many instances the best quality of instruction cannot be offered on prevailing salary schedules, and good teachers who may be developed are soon lost.

2. 50 per cent. of the institutions offering mining courses have each less than seventy-five students enrolled in mining, and 25 per cent. have each less than fifty mining students. with the exception of the few institutions in which work in mining engineering is now conducted on a strictly professional basis and some relatively young schools that can look forward to early and notable increases in registration, it is hardly conceivable that the relatively small mining colleges can afford to provide the equipment and instruction that a highly diversified technical course demands. Where such facilities are offered, the cost per student may usually be exorbitant, and it would seem to be wise for the administrators of these institutions to investigate the desirability of discontinuing the work in mining and devoting the money now spent there on work for which there is greater demand. At least two schools offering mining courses in 1910 have abolished them, and it is to be hoped that others will follow their example. The figures quoted would seem to substantiate the statement made by a considerable number of mining educators that while there may not be too many mining students, there are certainly too many mining schools; and it is certainly true that a young man who desires to study mining engineering should in justice to himself study carefully the equipment available and the advantages offered by several institutions before enrolling in a mining course.

### Discussion of "The Development of Mining Engineering."

**Arthur M. Greene:** Mr. Chairman and members: I would like to say that at Princeton University we have enlarged our School of Engineering, and in planning this enlargement we included mining engineering. This was done primarily because a number of Princeton men were interested in mining.

We realized the points brought out by the paper, that there are a number of excellent mining schools throughout the country, and that the expense of equipping a new school would be enormous. The trustees therefore arranged the plan to utilize our facilities in geology and chemistry and prepare our students so that within two years after leaving us they could receive a mining degree at some of the better and larged mining schools in the country. I think that is absolutely in line with the paper. We have geological facilities, but to equip a plant to do proper work in mining we felt was unwise, in view of the fact that the country possesses a great number of excellent mining schools.

**O. K. Harlan:** I would like to ask Dean Greene how many years, and what degree they give in Princeton. In other words, I want to know something more in detail of the arrangement of the school in mining engineering at Princeton. Do they give a four-year course, the first two years being a general liberal arts education, and the next two years devoted more particularly to the mining engineering work, metallurgy and so forth, and do they give a degree in four years, a Master's degree, simply preparing them for the more advanced engineering work? Dean Greene spoke of their students going to some other institution for further mining engineering work. I would like to have a little more information about that, if you please.

**Dean Greene:** I would like to say that in regard to mining engineering, we feel we can only take our graduate to within two years of his mining degree. The work in liberal arts, if you choose to call it that, is extended through the four years at Princeton. We include the technical subjects of mathematics, physics, chemistry, geology and mineralogy, and then leave the straight mining work to the mining school. We, of course, plan our work so that we can anticipate all but two years of the strictly mining work. Of course we will have to arrange that work so that the man can fit his work into that of a mining school. If we find on study that our graduate could not get his degree in less than three years, we will have

to anticipate more of the descriptive mining work at Princeton. We include in the curriculum four terms of economics and about two terms of straight elective work. Usually one year of work at Princeton will cover the foreign language requirement. The English is given in the Freshman year, and also the Senior year. The degree will be Bachelor of Science in Engineering at the end of four years. It is very evident that in mining engineering, the degrees may not be quite right, but we feel that in giving the man the fundamentals of engineering we should give him a Bachelor's degree. The alumni at Princeton are very insistent that the word "engineering" should come in. Personally, I feel that the word "engineering" should be left out, because it is really a scientific course, and it includes a number of collegiate subjects.

**Professor Harlan:** You have already instituted it.

**Dean Greene:** We have already instituted it, but the curriculum is subject to change. We have about four students who wish to take mining engineering at Princeton.

**Professor Harlan:** You started that last year.

**Dean Greene:** It was started three years ago but we have no mining engineers in the junior class.

**F. P. McKibben:** This is an excellent paper. And there are several outstanding points in it.

In the first place, the paper points to elimination of some of the descriptive courses included in our technical curricula. This is a good suggestion. Not long ago while visiting the Ecole des Mines in Paris I was impressed with the absence of large apparatus for illustrating work of a descriptive nature, and with the presence of a great deal of apparatus for the study of pure science in connection with the course.

Another suggestion which the author makes is that courses in applied economics be included in technical courses. I have recently had occasion to revise the curriculum of a civil engineering course, and by eliminating some descriptive and some highly specialized civil engineering subjects, and by including certain important courses in applied economics we not only

arouse the students' interest in a larger field but we increase their interest in the remaining important technical subjects.

**C. M. Young:** The remark of President McNair on the attitude of mind of the student toward subjects which he cannot approach with mathematical definiteness, is quite important.

At the University of Kansas, we have a course in mining law. We could give it in the department of Mining Engineering, but it seems to us best that it be given in the law school, in order that the student may get the attitude of mind of men trained in law. Instructors in law are often engaged in legal controversies, and their attitude of mind is quite different from that of the engineer, but it is the attitude which the engineer will encounter when he becomes involved in questions of law. Therefore we desire that Mining Law be given in the School of Law, not that we think the student will get any more mining law, but that he will be influenced by a different attitude of mind.

While I am here, may I mention one other thing? Dean Butler's paper has dealt with changes in the past. I want to suggest one possible change in mining curricula in the future which, if it occurs, and I think it will, will be due to the increasing prominence of engineering in the fuel industries. In the past, we have thought of mining and metallurgy as dealing with metals and non-metals. It seems quite possible that in the future there will be a division into fuels and non-fuels, and that there may grow up, and should grow up, training in fuel industries. These industries have in the past been slow to absorb technically trained men, altogether too slow for their own good, but it seems to me absolutely necessary that they be provided with trained men in the future, and that the schools must provide such men through more extensive training in fuel engineering than is now given.

**Max W. Ball:** I have some hesitation about getting up in this meeting and attempting to speak. I am an outsider, and neither a member nor an educator. Nevertheless I have an interest in certain phases of educational work, and some things on my mind that, with your permission, I'd like to say.

I have had in mind just the point that Mr. Young raised with regard to the need of training engineers for the fuel industries. I should like to hear Mr. Young or some one equally informed on the subject discuss further the need for and opportunity awaiting the coal engineer, but the message I should like to bring is that there is great need for and abundant opportunity awaiting the man trained in the engineering of oil and gas.

Curiously enough, although the oil and gas industry has become, I believe, the second industry in the United States, the need of engineers trained for the production of these minerals has only begun to be recognized and the training of such men only recently attempted. Petroleum engineering is apparently still unthought of by many mining educators, as is indicated, for example, by the fact that Dean Butler, in the otherwise splendid review to which you have just listened, refers to it not at all. His nearest approach to it is his rather casual statement that some mining schools have introduced courses in oil geology and that some of their graduates have found difficulty in finding positions.

He seems to infer that the oil industry is an evanescent thing, born of a boom and destined to an early decline. People have been predicting such a calamity for fifty years, and meanwhile the industry has kept on growing. Eight years ago I was one of a U. S. Geological Survey Committee of four that predicted the early decline of oil production—and to-day the production is nearly twice as great as then. The oil industry has more ups and downs than most, and some day it may peter out, but not until high-speed machinery is made to run without lubricants, and some substitute is found for the internal combustion engine. The coming of that day need not worry our mining-school students for some years ahead.

As for geologic graduates who have not readily found jobs, do you know of any branch of engineering in which good men have been so continuously in demand and in which the remuneration has been so high? I don't. True it is that during most of the time since 1920 the industry has been in a pro-

found depression, and that as a consequence the recent graduate has found it hard to locate a good job; in fact many of the older men have found it hard to keep jobs they had or to get new ones. But hasn't the same been true in the other branches of engineering during the same depressed period? Have no mining or metallurgical graduates found jobs hard to locate? It is safe to say that during the past ten years no other engineer has been so steadily employed at such high salaries as the oil geologist.

I am inclined to think that this rather abnormal period of "easy pickings" is about ready to begin to draw to an end. Before many years the supply of good oil geologists will overtake the demand, the profession will become, like other professions, a matter of survival of the fittest, and the high rewards that to-day go almost equally to the strong and those not so strong will go to the strong alone. But the decline in domestic production that will some day come will mean a need for more rather than fewer oil geologists; new branches of oil geology are constantly developing, and the man of high qualifications will find oil geology a welcoming and lucrative profession for a long time to come.

However, I had not intended to talk at length about the geologist. The need for him is well recognized and is being met. The new and almost unrecognized need is for the oil engineer.

Those of you who remember, and I suppose all of you do, the time when mining was a high-grade game, with bonanzas at the grass roots and fortunes just below the outcrop, remember that mining engineers were not in great demand in those halcyon days. Any long-wiskered prospector with a pick and a burro could find a mine, and anybody's nephew from Back East could run it. It did not take a mining engineering education, or indeed much education of any kind, to make a mine pay under those happy circumstances. But when the values began to decline, the depths to increase, and profits per ton to be measured in cents instead of dollars, then the man who could mine and treat ore for a little less per

ton began to take charge of operations. And, lo, the mining engineer had come into his own!

Now, speaking still in terms of metal mining, the oil industry ceased long ago to be exclusively a high-grade proposition; year by year it becomes increasingly a low-grade problem. Popular belief pictures all oil wells as gushers and all oil men as rolling in gratuitous wealth, and some oil wells do gush and some oil men are ruined by riches, but the industry as a whole is and always will be a business of careful operations on a small margin. The typical symbol of the industry is the pumping-jack, not the control head.

According to the most recent Government statistics I have seen the average daily production per well in the United States is five and one-half barrels. Think that over for a while. Consider it next time you buy a quart of medium. Picture the great flowing wells of Long Beach and Tonkawa, and then picture the thousands and thousands of small wells that bring the average down to five and a half barrels a well a day. Then remember that the number of declining wells is increasing week by week, and decide whether or not oil production is going to need technically trained men.

The industry itself has not yet fully realized the need for trained production engineers, but the larger companies are beginning to realize it, and the man who has a good technical education and in addition a good line of oil field experience has a good job waiting for him. Such men are few, and the oil industry already wishes there were more of them.

The duty and the opportunity for the mining school are obvious. Such a school, if it is situated in a region where oil is produced, should be turning out men qualified to go into the oil fields and, with proper experience, became pretroleum engineers. The school so situated that does not do so is neglecting its duty to an important industry and over-looking an opportunity to enlarge its usefulness.

As an example of the need, and of a serious and, I think, successful attempt to meet it, let me mention the Colorado School of Mines, at Golden, with whose work I am a little

familiar. The School celebrated its fiftieth anniversary last month, and during those fifty years, until the past three, it has been essentially and exclusively a metal mining school. Yet, I am quite sure, more of its graduates are in the oil business today than in metal mining and metallurgy combined. Just let that soak in, if you please. Fifty years a metal mining school, and more alumni in oil than in metal mining! Do we require any further illustration of the needs of the oil industry?

And some three years ago the President and the Board of Trustees (I was not on the Board then, so I speak freely) had the vision to realize the need and the foresight to put in a course in petroleum engineering. They were fortunate enough to secure a man who had had experience in practically all phases of oil engineering. He had been a field geologist, had been in the production game, had built pipe lines, and had built refineries. He was probably the only such all-round man in captivity, and unfortunately he did not stay in captivity long. He went away at a ten thousand dollar salary, and when we (I was on the Board in time to share this difficulty) tried to find a successor we found he did not exist. Then we awoke to the fact that we were trying to teach the whole of petroleum engineering with a one-man faculty, which is precisely comparable to trying to teach the whole of mining engineering and metallurgical engineering with one man.

Now we are endeavoring to build up the course, and to make it comparable to the mining and metallurgical courses. Our present man is strong on refining; we are on the trail of a man who will be equally strong on production; we hope next year to add a transportation man; and thus we plan to build up a faculty that will be equal in numbers and strength to the mining and metallurgical faculties. We are not attempting to do it suddenly, but as rapidly as consistent with sound growth we hope to make the petroleum course as comprehensive, as varied, and as responsive to the industry as any engineering course anywhere.

What the Colorado School of Mines is doing can, and in

my opinion should, be done by every other school of mines situated in an oil region. And that this is not alone my opinion is shown by the following resolution, adopted by the American Association of Petroleum Geologists, which is the largest organization of geologists in the world, at its annual meeting in March:

"*Resolved,* That the American Association of Petroleum Geologists considers systematic training in petroleum engineering highly desirable, and recommends that more and better facilities for such training be provided, particularly in those States that produce oil commercially."

In conclusion let me add two words:

First, the boy who goes out of a mining school to be a petroleum production engineer must be prepared to serve a long and exceptionally arduous apprenticeship before he is ready for much advancement. The drilling and handling of oil wells is a difficult, highly specialized, and highly skillful task. It requires a great degree of manual proficiency and a greater degree of mental experience than any other operation with which I am familiar. The graduate who enters a mine may learn to muck, tram, and timber in a few months; the graduate who goes to the oil fields will advance more rapidly than his untrained associates from bull-gang to construction-gang, from rough neck to tool-dresser to driller, but his bunk-house existence is likely to last three or four or five years. The rewards are, I believe, likely to be worth while, but only boys of good physical stamina and exceptional mental and spiritual staying qualities should be encouraged to start so long and trying a journey.

Second, the boy who succeeds in petroleum production engineering must have the highest mental preparation. He will be in competition, not with Italian miners, but with some of the most highly specialized and most efficient mechanics in all industry. The man who conducts successful operations with tools weighing a ton or so, suspended at the end of a cable half a mile or a mile below him, is a man whose ability commands respect, and the graduate who in time can become

worthy to supervise him must possess every physical, mental, and educational qualification.

I must apologize for having talked several times as long as I had intended. The subject is one about which I feel rather strongly and express myself, I fear, at too much length. If what I have had to say has not been wholly in line with the matters you are met to consider, or has not be of importance in the attainment of your objects, I apologize doubly.

**G. B. Pegram:** I think what I have to say could more properly be considered as a discussion of the paper by Dean Butler, because he has in that paper indicated clearly what the working out of this long curriculum is; but I shall be glad to take just a few minutes to point out a few features of our experience at Columbia with the so-called six year course.

I think everyone knows by this time what is meant by a "six year course," not a six year course in mining engineering, but rather a professional course in mining engineering based on scientific and general education, such as one gets in a liberal arts college. It was instituted at Columbia for the reasons that have led a great many engineers and teachers of engineering, to believe that we ought to work towards a longer professional course in engineering I may say the two questions before us were, first, would a course of this type afford an education which could be proved to be superior to that which we and other schools had been giving in the ordinary four year course; and, second, would a sufficient number of students realize the superiority of this course to give it that support which would justify its continuance. As to the first question, there was little doubt. As to whether the individual student in laying out his education would do better for himself by taking a college course first and then a professional engineering course afterwards, opinion has been general that if the student has ambition and ability, he is certainly justified in taking six years in attaining his general and professional education. I think that certainly we have yet to hear of any single case in which a man has done that and thereafter regretted a single week of time spent on his

education. That was perfectly clear. The real question for us was whether or not by confining admission entirely to the type of man who had attained a good general college education before coming for his professional engineering course, we would by virtue of the greater homogeneity of the students, and better preparation in general, be able to give superior instruction in engineering subjects. I believe there is no question in the minds of any of us at Columbia that the answer to that question is favorable, that we are able to give a superior type of engineering instruction because of the fact that we limit ourselves entirely to students of more maturity and that better selection which comes with the fact that the student makes his decision to go in for a professional engineering course only after he has had three years of college work. We are satisfied with the answer to that question. The other question, whether or not a sufficient number of students would desire to take this course to make it desirable or possible to continue it, is still in process of being answered. Frankly, the number of students we have had in mining engineering is not as great as we expected, and if we figure out the cost per student, it does come to an extravagant figure, but it is not quite so bad as one might be led to suppose by some of the figures in Dean Butler's paper, because in any estimate of the number of students from whom we receive tuition fees to help support the course, we must add the pre-engineering students who are registered in Columbia College. They are taking mathematics, chemistry, physics and drafting, and would, of course, in the days of the four-year course, have been registered in the engineering school and counted as engineering school students.

We have been graduating on an average five mining engineering students a year since 1918, whereas before that we had been graduating for some time an average of about 30. In metallurgy, we have been graduating an average of about three since the new plan went into effect, and that is about the same as the number we had in metallurgy in the the four-year course. Marked fluctuations take place. For instance, this

year we graduated only three in mining engineering; next year we will graduate probably thirteen of fourteen; the following year, about the same number, and after that it looks as if the number will drop down sharply again to not more than four or five. I do not know exactly why these sharp fluctuations take place in mining engineering.

Since we have instituted this curriculum, we have, of course, been experimenting, as one naturally would with a new arrangement of this kind, to arrive at the best arrangement of the curriculum itself. I shall not go into any detail about that, but I may say that in general the tendency in the mining engineering course, and in all our other engineering courses, is toward a professional course which shall approximate more nearly the nature of a non-professional graduate course. In other words, we find we are continually introducing more electives, or choices which the student may make, and having less and less a strictly required course. That is largely a matter of the attitude of mind of the student who has graduated from an undergraduate course, as all our students have, practically. They are mature enough to realize pretty clearly what they want, and we have come to the conclusion that, as in the case of the non-professional graduate student who comes to the University and chooses what he likes we will do better by permitting much freedom of choice in the latter years of our engineering course. As a matter of fact, just as with non-professional graduate students, the case is very rare in which a man makes a selection of a group of studies that are obviously not well adapted to his needs. There is a tendency toward making use of the excellent opportunities which the rapid development of our School of Business offers, by making more and more use of the staff of that School in connection with the courses offered in mining engineering and in the other engineering subjects, and there also seems to be a rather definite tendency toward a greater election of courses in what may be called pure sciences.

Now, I shall not say more about the changes in the curriculum we have made, but will refer for a moment to the

changes in admission requirements. When we started out we had a very heavy requirement in physics for admission, a pretty high requirement in mathematics, and a pretty high requirement in chemistry. We have found, by experience that while students can, if they have enough foresight, get the preparation that is required in almost any good college, it is a very small number of students that have this foresight, and we have therefore been forced to modify our admission requirement simply by decreasing the amount of mathematics, the amount of chemistry and the amount of physics required for admission, and carrying some of those subjects over into the professional engineering course. That has made it considerably easier for graduates of liberal arts colleges to be admitted. Just at present we are going somewhat further in the direction of easing the way to admission, to see whether or not the number of students in attendance will be very greatly affected by it. The faculty has recently adopted resolutions which make it possible for a student who enters Columbia College with his elementary physics, elementary chemistry and advanced mathematics, and also foreign language, offered as entrance subjects, to be admitted into the engineering schools after not three full years of undergradate work in Columbia College, but after two years of rather heavy work, and one summer session, making practically a five year course. We do not think that any students would start in the college course, or the combined college and engineering course, with the prospect of having no degree at all until after five years. It is therefore provided that this special class of students will receive a Bachelor of Science degree at the end of four years, and the Engineering degree may then be obtained at the end of the next year. We expect that nearly all of those students who receive a Bachelor of Science degree will stay to complete the work for the Engineering degree. It has been our experience that students are not very likely to drop out in the later year of an engineering course; they may drop out for a year or two, but they come back. Most of them have the ambition and the ability, be-

cause they have been pretty thoroughly weeded out, to go on except, I should say, some students who come to us from other institutions and who have not had the preparation that they should have had, nor the preparation they thought they had when they came. It is a sad fact that we find it hard to judge the preparation which students have had when they come to us from colleges, liberal art colleges; they think they have had good mathematics, good physics and good chemistry, but it frequently happens that the work has not been thorough enough to keep to the standard set for the first year of our three year engineering course. A good many come to us; we put them in courses for which they seem prepared and think we have done it right, and then we discover we have done them an injustice.

That, I think, expresses about the status of our experience at Columbia at the present time. Our Trustees went into this with just the idea expressed by President McNair. It is the duty of some institutions in this country to try university professional courses in engineering which are on a par with the professional courses that are offered in the older professions of law and medicine in the best professional schools. I thank you.

**Chairman Fulton**: I am sure we have all appreciated Dean Pegram's paper. Is there any discussion of this question?

**Professor Chatburn**: I would like to ask Dean Pegram if they give the professional degree at the end of five or six years. He said they gave the Bachelor degree at the end of four years.

**Dean Pegram**: The degree given is a professional degree, as metallurgical engineer.

**Dean Thomson**: May I ask, do you have a number of students coming to you who take this professional course after they have completed, or obtained, perhaps, a B.S. degree in some good liberal arts college with good sound scientific training, or, if you do not, what would be your estimate of the length of time it would take a student, having a good sound

B.S. preparation, to complete your course? Would he normally do it in about two years?

**Dean Pegram:** Mr. Chairman, the student who comes through a liberal arts college, if he is looking forward to studying engineering at Columbia or elsewhere will, if he is well advised, have taken mathematics, physics, chemistry, and perhaps some drafting, and then he will enter the first year of our three-year course, and it will take three years to graduate; on the other hand, if the student has had an undergraduate engineering course, and has a B.S. in engineering, and comes to us, he usually spends two years taking the professional course, the reason being that our course is a broader course than the four-year course. The mining engineer takes more mechanical engineering, more electrical engineering, more chemical engineering, than he gets a chance at it in the four-year course.

## Discussion of "Recognition of the Individual," by C. E. Seashore.

**D. C. Jackson:** I want to express my thanks to Dean Seashore. The discussion shows the Society's indebtedness to him for this thoughful, wise and scholarly paper.

I have had ten years' experience with sectionalizing classes on the basis of student records; not taking solely their scholastic records, but associating that in a sense with the ambitions as indicated by the characteristics of their scholastic work. It gives admirable results. It can only be done, however, I will say to my engineering confreres, in a department which has a large number of students, that is, three to five sections in a particular class, like a Sophomore or Junior or Senior class, and consequently some of the difficulties such as Professor Risley has referred to may be due to the fact that

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there are not a sufficient number of students in some departments to deal with the problem effectually. Any one who thinks of the matter as a fad notion may find reasons for reviewing his opinion set forth in the paper which Dean Seashore published a couple of years ago in pamphlet form, which was entitled, I think, "Sectioning for Ability." We do not find that such sectioning of the classes in my department causes dissensions or bickering amongst the students as sugeted by one speaker. We begin such sectioning in the Sophomore year. Of our low-grade section, if you want to call it that—we don't call it that—we call it the section made up of the mentally less mature students, who are, as yet, slower in action: I will say that the difference of treatment between that section and our higher grade sections does not result in discontent or dissatisfaction. The men in the lower sections are encouraged to strive to get in a higher section. The men in the upper section have many privileges; they practically choose their own methods of study and are urged to do both broader and more thorough work in their subjects by reading, reflection, discussion, and working on independent problems; but all the sections are kept synchronous in text-books assignments. That is, the higher section are encouraged to reach accomplishment for themselves in the ground covered, while the lower sections are more closely limited to the text-books and set problems. This larger independence is something worth striving for, and the students appreciate that fact. Moreover students in my department have a considerable degree of election between subjects in their senior year; which must be approved by the head of the department, and the extent of independence allowed to them in this is made subject to past records, which gives another incentive to do well in the preceding years.

We get a lot of graduate students who choose to take up advanced study because they have earned and utilized these privileges as undergraduates and have learned the desirability of going farther in study under conditions of still greater independence. After having learned the joys of accomplish-

ment through such methods, such young men become graduate students of high professional grade, and our experience proves that they accomplish a good end by staying for an additional year or even more of study.

As has been said in the discussion, there are many difficulties in this plan, but the results well repay the effort to overcome them. There is no reason why we should teach poorly because it is difficult to teach well.

Finally, I want to assure you that such sectioning must be done with judgment and care and the methods of teaching be carefully adapted, in order that the results may be desirable.

**P. F. Walker:** If I may be pardoned, I wish to merely remark, in the line of discussion, my gratification of Dean Seashore's mention of the business profession, combined with cultural work, in the shorter course. I have felt all along that one of the things which we could not escape, as we discussed the curriculum, is providing for the student who is not fitted to avail himself of the possibilities that might be provided for in a longer course. Without discussing that, I merely comment upon it as a matter of gratification.

**J. H. Felgar:** What is the attitude of the students among each other, those that are in the higher grades, towards those that are in the lower grades, their general attitude, as far as conversation, and possible social relation? Is there any comment on the interrogatory?

**Dean Seashore:** I think I should say that it is about the same as in daily life; some are good looking, some are not good looking, some are stout, some are thin, some are tall and some are short, and they gradually get used to it.

**J. R. Macarthur:** I think perhaps you would be interested to know that at the California Institute of Technology, we have instituted at least some of the things of which Dean Seashore has spoken. I might say in the beginning that we limit the number of our students to 160 in the Freshman year. Heretofore, we have limited them on the basis of high school credentials. As we have found that in many cases those credentials are not satisfactory, this fall we are beginning to re-

quire, in addition to the credentials, an entrance examination, and our selection is going to be made henceforth on that basis. The year before last, at the close of the first term, we sectioned our Freshmen on the basis of the term grades. We made one honor section, and the rest were left pretty much as they were. Last fall when the Freshman class came in, we held an examination. We had two days for registration. We registered our 160 Freshmen the first day, and on the second day we gave them, without previous notice, a general examination, an examination that was a test not so much of accurate knowledge, as of ability to use certain general principles in mathematics and physics and chemistry that we felt they ought to know, if they were going to do our work at all. We sectioned them, making two honor sections of twenty each grading them from the highest down to the fortieth, and then choosing the rest alphabetically. At the close of the first term we removed some from the honor sections and promoted certain others to them. We did not feel after the second term that we could do anything of that kind. This year we are having entrance examinations, one in June, and another in the fall, and we are going to section them from the beginning on the basis of their results. Our experience with the honor sections has been most encouraging. The men in the honor sections can cover much more ground than those in the other sections. For instance, in chemistry, they cover the work of the whole year in two terms, and in the third term are able to do Sophomore chemistry. In regard to the attitude of the other students to those in the honor sections, I may say that it is true that the other students are used to them, but they regard them with a certain amount of disfavor. I do not know how Dean Seashore is going to create an attitude among the students that will encourage the students to become men of the highest type.

**Professor Macarthur:** They express their disfavor by derogatory remarks. They simply look upon the men in the honor sections with disfavor, some saying that if they wanted to put all their time on their work in that way they could

probably achieve as much. One of our problems is how to give these honor men more liberties. We are trying to demonstrate to them that they do not need all the class time to do the work, and we are thinking of arranging the work in such a way that they shall attend only a certain number of class exercises and be free to do their work outside. In the third term in chemistry of the Freshman year, the men are allowed to do individual laboratory work, of course under supervision, and I think we succeed in the majority of cases in adapting the work to the individual capacity.

**Dean Seashore:** I should like to say, or comment on the last point made, by saying that probably the finest exhibition of teaching which you will find in the United States at the present time for good students is on the football field. I have watched Howard Jones, seeing how he handles the students, and I have often said, "There are teachers who can go down there and learn how to handle a good student." We can cultivate the academic life in this way, and attain the same atmosphere.

**Dean Evans:** Dean Seashore speaks of education for democracy. We all believe in that. In an institution such as the University of Colorado, a state supported University, it must be kept in mind, however, that we must do our best to educate all classes, not only the youth who has been surrounded by a democratic atmosphere all his life, but the aristocrat as well. The poor man's son and the rich man's son must and should be given the same opportunities and the same consideration. The State University is a part of the State educational system, all tax supported, and I believe we must be very careful about imposing special preliminary examinations and mental qualifying tests as prerequisites for admission. If mental tests and examinations could be made infallible in indicating a young man's ability to carry an engineering course successfully, their use might be warranted by all types of institutions. Until such methods give a more accurate measure of a man's native ability, they should not be used to determine admission to our engineering colleges.

**Dean Seashore:** In regard to the qualifying examinations, and the responsibility upon the School Boards, we provide for that by providing that these examinations shall be operated as a national standard, and that School Boards may give the students the privilege of taking it by the payment of a dollar. Nobody is required to take it. If anybody wants to measure himself, he can be measured, and the teacher supervise it, and those at the college have nothing to do with that. It is absolutely a cold-blooded national standard.

**G. B. Thomas:** May I speak as a purchaser of technical graduates rather than as a trainer. Although I have had ten years' experience from the training standpoint as an engineering teacher, my contact with the engineering schools during the past few years has been as a purchaser of your output.

Dean Seashore has outlined in an inspiring and wonderful way his ideas on the better selection and training of engineering students. His proposals on courses of variable length and content according to the students' ability would have aroused my opposition when as a trainer I felt the sanctity of the traditional four-year course and saw the difficulties in arranging and conducting courses of adjustable content. Now after several years as a purchaser, I have considerable sympathy for the things proposed here this morning. Most of us feel that some changes are desirable, but there would be great difficulty in getting agreement on what these changes should be.

However, there is one thing engineering teachers agree upon and that is that each one of us does a better job than the other fellow does. As a purchaser, I feel I do a better job in coming to your institutions and coöperating with you than other industrial representatives do. You see I am just as egotistical as I used to be as a teacher. Perhaps there is not much foundation for that feeling. However, there is considerable justification for the feeling on the part of each engineering school that it is making an individual contribution to educational progress. Every now and then, I am asked if one institution is not better than another and I have been asked by my friends to name the five best engineering schools in the coun-

try; the other day I was asked to name the five best engineering teachers. I say that none of these questions can be answered definitely. As a purchaser of the services of their graduates, I feel that each and every school trains men worthy of consideration for employment.

Another thing proposed by Dean Seashore is the study of jobs undertaken by engineering graduates. The job is the next step in the experience of the young man finishing college. The college course is merely a section of the whole life. That section should be planned with relation to the whole. Now as trainers and sellers of technical men, I believe engineering teachers will have to get a better understanding of the manpower needs of industry. Every year we find an increase in coöperation of engineering faculties in trying to understand our needs for men. But we should go further still. More educators should really know what is needed in given industries.

Then it will be realized that there are places in industry which do not require a large amount of technical training and ability. The proposed courses of one, two, or three years duration can be laid out to equip the less proficient students for these less technically exacting jobs. This would release the more capable men for the more exacting jobs. Thus the graduates of the various courses of different length and content would each be better fitted for the work he undertakes and the needs of industry be more adequately met by the available, limited supply of technically trained men.

**G. R. Chatburn**: Mr. President: It seems to me that the papers yesterday afternoon and this morning bring forcibly to our mind the fact that it makes very little difference what engineering subjects a curriculum contains, but success depends largely upon the method of handling that curriculum. It makes very little difference whether we all have the same curriculum over the whole United States, or not, we will get about the same results in the long run. I am glad that Dean Seashore spoke this morning about those people who are not the best, and that we owe to them something, a great deal, in

fact. Many men who have failed in our colleges have gone out and are successful business men. We all know of them. General U. S. Grant, for example, was perhaps the lowest, or among the lowest in his class, at graduation, and we know what he did for this country during the great Civil War. We realize that those students who through immaturity or lack of mental capacity fall below the upper rank in scholarship, and those who for various causes drop out of school before graduation, are men who have some place in the world of affairs, and that it is the duty of the engineering college to arrange its curriculum with them also in mind.

### Discussion of "The Freshmen" by C. L. White.

**A. M. Greene:** There is one question I would like to ask Professor White—if he would give us one or two samples of the problems which these men have, if he can give that verbally, so that we who do not have this system might know just what is done at the problem hour.

**C. L. White:** At the first meeting of the problem class, in order to get a score on them, we always give them something. We give them a sort of a general lay-out of an engineering structure or plant; sometimes we use a rock crushing plant, where the rock to be crushed is drawn up an incline, and we tell them the proposition is to investigate the whole lay-out. There is the question of power, time rates, dynamos and the strength of the cable pulling the car up the incline. For an hour or so we talk about what is to be investigated and impress upon them at first that the important thing in any engineering investigation is the load, what the structure or machine will have to do, and then before it degenerates into sort of a loose discussion, we give them a problem. This may be for the first time merely a review in mathematics, or something that will be needed in working the prob-

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lem out, and they work it out just as they see fit. That is a problem to get exhibit A on them. We keep that problem to the end of the quarter and show it to them at that time to see if they will deny it. Then, that gives us a chance to bring in the training idea. They even think they are going to be engineers right away, and that helps us wonderfully in training on little but important items. We give them a problem similar to the one they worked out as they saw fit, giving them specifications to follow, and then we go on from that first study problem, by means of shorter problems, and get into the mechanics of motion, and then any problem you want to give them in the mechanics of motion may be used. The reason the shifting is so easily made, is that we don't deal with very many principles. It is simply the way in which the basic laws are applied. When we come to really investigating whether the cable is strong enough, the question then comes up of when the pull is greatest upon the cable. Once in a while there is a man who feels that the greatest pull upon the cable is when the acceleration is at the maximum amount. At our weekly conference among the instructors, we merely cover the same phase. If one man gives a problem on acceleration, then the others do also. The man that is on A section gives a little harder problem; the man that is on B section, gives an easier problem, but nevertheless they make the same number of points. I might say that the students made no objection to the point system, although they did object to this psychology test basis. A few made a bitter denunciation of this scheme. The great majority, however, are good enough sports to take the handicap and see what they get out of it.

**Professor Caldwell:** May I ask what mechanical tests you use?

**Professor White:** I do not use any. I take the University tests, of course, given by the psychology department.

**Professor Caldwell:** At the University?

**Professor White:** Yes; so that I am not responsible for that. If it is wrong, I am all right, and if it is right, I am

all right, because the result shows only about 4 per cent. of the grades affected.

**Professor Caldwell**: The object of my question is this: If this Society is going to take this vivid interest in the human engineer, you must learn the name of these tests and their evolution, because even when you measure an expanding piece of iron, the human element enters there. Therefore, I hope the Society will mention the name of the test.

**Dean Seashore**: May I suggest that when these tests are used, and they must be used, you should use the specific test for that subject, and not a general engineering test. To illustrate: A given student may have especial aptitude for English, or language, and may be utterly lacking of any aptitude for mathematics. It is manifestly unfair to check that student's progress in mathematics on a rating which does not take that into account. That is the reason I took occasion yesterday to urge that each department make its own tests representative of two factors, first, the inability for this kind of a subject, and, second, quality of the preparation that the student has had. When you do this by this very interesting method that Professor White has shown, you will have a much more fair basis of praise and blame.

**Professor White**: I work in close coöperation with the psychology department; and as I understood Professor Wilson, his test was devised to bring out latent ability, and that achievement which might result in any class would be largely dependent upon effort, and the high rating in the intelligence test would be achievement without effort. If they put forth effort, they were not testing their latent intelligence. I think nearly everybody was working through the quarter, and at the end of the quarter the men were in those places, indicated on the chart, so that even if it was wrong it was not so serious. Those men with high psychology tests would really seem to have ability to do this thing, and on the whole they actually went ahead and did it, so that was as far as I went into it.

**President Walker**: This represents in general, as it appeals to me, a thing, a method or process, rather, which is growing

to some extent. I know that there are several institutions which have introduced the problem course for Freshmen. We have done it ourselves at Kansas, and I know they are doing it at Ames.

**G. C. Shaad:** I listened to Professor White's paper and from some of the discussion I feel that possibly the work we are doing at Kansas along this line is somewhat crude, although I, personally, am expecting favorable results from it, and hope to see it improved from year to year in the details of the manner in which it is carried out. At the present time we have used it mainly as an inspiration course, and a course of study which would help the student to find himself a little better along engineering lines. To that end we group our students in small sections and make it possible for each group to meet one of the older teachers in each of the main lines of engineering work, electrical, mechanical, and civil, and so forth. The men are changed in sections every six weeks, and they meet three times a week in assigned problem work. In the problem work we aim at something of the mechanical manner in which calculations are carried out, something of the fundamentals of the proper reporting of results, and we so select the problems as to give the students some conception of what engineering problems are like, and some idea of the application of the fundamental subjects to engineering work. We feel that the work so far has been more than worth while. We expect to accomplish a great deal more with it. One of the things which is rather gratifying to those of us who have been willing to give our time to the instruction of the Freshmen is the fact that it so happened that in the department of Physics, where there were two sections, one of which had had our problem work as a sort of introduction, although no Physics, as such, was taught to them, and the other section, the students of which did not have the problem work; the instructor in physics immediately reported to the Engineering School that the section which had the problem work experience was taking hold of the work in Physics much more satis-

factorily than the other section which had not been exposed to the problem work.

**President Walker:** Our Professor Johnson who has charge of this course with us, prepared a chart, of which we have several copies, and we will have those sheets passed around. My thought was that while the chart does not correspond exactly with what Professor White has shown, it might show how our men are measuring up to the intelligence test. This was done very hastily. Each individual check on this diagram that is being passed around represents a student. The high ranking man in the intelligence test is high up on the scale, and the high ranking man in the problem course, over to the right. You will notice that there are a few men who make a very high rank in the problem course, who run low in the intelligence test. That brings several points over in the lower right hand corner; but I want it made clear that this chart does not represent any progressive study or effort through the semester to compare in any way with the principle which Professor White has put forth. It merely is a record of what happened.

**Dean Seashore:** May I offer one suggestion for those who wish to try this method, and that is to arrange the records in such a way that there is no jumping off place for the average student. Cut out a large field for achievement, and let it be shown what the exceptional student is doing away and apart from the rest. There are a great many devices now in use for that purpose, and it is a very wholesome thing to let that law operate in a socialized way. The main point I want to bring to your attention is that there should not be a narrow group of achievement. There should be a large field open, and the man who has genius should be recognized standing out apart from the rest in the problem class.

**A. N. Talbot:** Is the practice at the University of Washington the same as that given by Dean Marston for Iowa State College—that of selecting the instructors for this freshman work from the older members of the faculty? If so, after the years of trial is there difficulty in keeping these professors

interested in giving this instruction, and do they carry on this work better than younger men would?

**Professor White:** At the University of Washington the younger men are used as instructors in freshmen problems. They do not find it quite so burdensome to maintain a desirable insistence upon the element of training in the proper methods of performing the work. The manner of conducting the course affords an excellent opportunity for training in teaching. The element of inspiration derivable from the older members of the faculty is provided by the talks described in the paper.

## THE DEPARTMENT OF ENGLISH.

A new plan for providing sympathetic and effective guidance for students whose language is other than English has this year been initiated by the College of Engineering at the University of Michigan. The problem which these foreign students present is so puzzling and often so difficult to solve that the new plan at Michigan may be of general interest to those schools to which such students come for study in any considerable numbers.

For at least ten years the foreign students in the Engineering College at Michigan have been allowed to substitute English for their modern language requirements, and the administration of their English, modern language, and cultural requirements has been vested in the head of the English Department. Such an elastic plan has proved very helpful in suiting the work to the individual needs of this peculiar class of students whose preparation, experience, and objectives varied so greatly. But it was still felt that a more comprehensive plan for the guidance of such students was needed,—a plan that would take into consideration all their work, not merely their language requirements. Accordingly by faculty action last June a standing committee was created on English for Foreign Students.

This new committee consists of the Head of the English Department, one other member of his staff nominated by him, a representative each from the Committee on Classification and on Delinquent Students. This committee has general charge of the work of all students whose native language is other than English. Upon matriculation and registration all such students report to the chairman of this committee who must determine whether they possess a sufficient knowledge of English to carry on the work of the College successfully. On his recommendation they may then be referred to the proper classifier, who is authorized to give them such a program of

work as he deems best. For his first semester, however, every foreign student is considered as on trial. If at the end of the semester he passes his work, credit is, of course, given; if, however, in spite of conscientious effort, he fails, and his difficulties are, in the judgment of his instructors and of the Committee on English, due primarily to his lack of facility in the use of the English language, his record is disregarded, but he is then remanded to the Department of English for such work in English as he needs, to the limit of eight hours.

If a student is judged by the Committee to be unfitted even for such a trial program, he is required to take for one semester such work in English as the Committee thinks necessary, and is required to visit regularly such classes as may, in the judgment of the Committee, be profitable for him.

The Committee is enthusiastic over the prospects of success for its work. The interviews with the foreign students on their arrival have given the chairman an opportunity to study deliberately and carefully each individual case, to determine with some care the exact status of each man, and to advise him as to his course. He was able to extend a real service to this considerable group of rather bewildered, puzzled students from the four corners of the earth. Moreover, by making his office the headquarters for every sort of service to them, he has been able to keep in rather close touch with their problems as they have occurred. A series of evening conferences for the whole group has been initiated, at which they have met each other and the entire membership of the Committee on English around a table. Here their difficulties and needs have been discussed with great frankness and they have been made to feel the desire of the Committee to help them adjust themselves to their new environment.

Once a week most of them—all who are free at the hour appointed—meet in a voluntary, self-constituted class for practice in speaking. The two members of the Committee having experience in the training of foreigners to speak English are present, not to preside but to criticize and help.

A system of reports has been worked out so that the Com-

mittee shall have frequent means of knowing exactly how far these students are hampered by their speech difficulties. The office records in the Chairman's office are thus to be kept complete and should for at least three semesters follow the progress of each student under his charge.

It is perhaps too early to predict results, but, as a plan which has evolved from ten years experience with this problem of the "stranger within our gates," it may be suggestive of one way, at least, to handle a difficult situation.

The personnel of the Committee on English is as follows: Chairman, J. Raleigh Nelson, A. C. Klocksiem, Horace King, H. H. Higbie. Any of these men would be glad to give further information of their work to anyone specially interested.

## ACTION TRANSMITTED TO INTERSTATE COMMERCE COMMISSION REGARDING THE DEATH OF PRESIDENT MCNAIR, MR. DUNLAP AND PROFESSOR IVES.

COLUMBUS, October 15, 1924.

DEAN F. L. BISHOP, Secretary S. P. E. E.
University of Pittsburgh,
Pittsburgh, Pa.

*Dear Sir:* At a recent meeting of the faculty of this university, I introduced a motion, a copy of which I inclose. President Thompson has been pleased to appoint Professor C. O. Ruggles, head of our Department of Business Organization and specialist on transportation; Professor T. E. French, head of our Department of Engineering Drawing and an eye-observer of the results of the accident; and Professor C. D. Laylin of our Law College, as our committee "to coöperate with other agencies to secure rulings from the Interstate Commerce Commission or legislation from the federal government tending to decrease accidents."

I take the liberty of bringing this matter to your attention with the thought that possibly you may be willing to bring this matter to the attention of the council of the S. P. E. E. in order that the colleges and societies interested in this particular accident, shall unite in some constructive work which will tend to decrease the number of such accidents and lessen the seriousness of the results.

It seems there is no Interstate Commerce or federal law preventing the insertion of a wooden coach or sleeper in steel equipment; although the Post Office Department has a law forbidding the use of wooden railway mail cars in a steel equipped train. It seems the practice on certain railroads is for the flagman to go back "a proper distance," whatever that may be, or not to go back at all. While it may be impossible to prevent a locomotive engineer passing his block

signal, as well as the human signal, it is thought that some punishment should be given to those engineers who take chances in this way.

Thanking you for your coöperation in this matter in any way which may seem to you to be desirable, I remain,

Very truly,

WM. T. MAGRUDER,
*Professor Mechanical Engineering.*

Because of the tragic deaths of Frederick W. Ives, Professor of Agricultural Engineering of this university, Frederick W. McNair, President of the Michigan College of Mines, and of John H. Dunlap, secretary of the American Society of Civil Engineers and one time professor of civil engineering at the State University of Iowa, on their return from the meeting of the Society for the Promotion of Engineering Education at Boulder, Colorado, on June 29 in a rear-end collision near Buda, Illinois, it is moved that the executive committee of five be appointed by the president to consider what can be done by the faculties and boards of trustees of this university and of the Michigan College of Mines and by the Councils of the American Society of Civil Engineers and of the Society for the Promotion of Engineering Education and the American Engineering Council to secure rulings by the Interstate Commerce Commission, or legislation by the federal government, which will tend to decrease the number of such accidents and lessen the seriousness of the results; and that this committee report its recommendations to this faculty at its earliest opportunity.

November 26, 1924.

MR. HENRY C. HALL,
Chairman, Interstate Commerce Commission,
Washington, D. C.

*Dear Mr. Hall:* The Society for the Promotion of Engineering Education is a national organization which has a membership of about 2,000 of the leading engineering teachers and consulting engineers of the country. The members of the

Council of this Society have requested me to write to you concerning the use in railway practice of wooden sleeping cars in trains with steel cars. This matter was brought to our attention because of the wreck at Buda, Illinois on the Chicago, Burlington and Quincy, June 30, 1924, which resulted in the death of three of our prominent members, Dr. F. W. McNair, President of the Michigan College of Mines, Mr. J. H. Dunlap, Secretary of the American Society of Civil Engineers and Mr. F. W. Ives, Professor of Agricultural Engineering at The Ohio State University. These gentlemen lost their lives on their return trip from the Annual Meeting of the Society for the Promotion of Engineering Education which had just been held in Boulder, Colorado.

It is our understanding that the tragic result of this collision on the Chicago, Burlington and Quincy Railroad was in part due to the use of wooden sleeping cars in steel-equipped trains. Therefore, moved by the great loss which this Society has suffered, the Council of the Society for the Promotion of Engineering Education wishes to protest formally against the further use of wooden sleeping and passenger cars between steel cars and further urges the complete abandonment of wooden passenger cars at as early a date as possible.

On behalf of the Society for the Promotion of Engineering Education, I ask that these matters have the careful and prompt attention and action of the Interstate Commerce Commission.

Respectfully submitted,

A. A. POTTER,
*President.*

## HIGHWAY EDUCATION BOARD. *

### JOHN LISKA, OF WISCONSIN RAPIDS, WISCONSIN, IS WINNER OF FIRESTONE SCHOLARSHIP IN FIFTH GOOD ROADS ESSAY CONTEST.

John Liska, high school youth of Wisconsin Rapids, Wisconsin, is announced as winner of the H. S. Firestone Four Years University Scholarship for 1924, his essay having been chosen as the best of those submitted in the fifth good roads essay contest.

Liska's essay represented Wisconsin in the national competition, in which one essay was entered from each state and territory. It had previously been selected as the best of those from his state by a committee named by the Extension Division of the University of Wisconsin. More than 200,000 high school students throughout the United States and territorial possessions sought the honor which fell to him. The contest was conducted by the Highway Education Board, of which Dr. J. J. Tigert, U. S. Commissioner of Education, is chairman.

National judges who reviewed the state essays were James J. Davis, Secretary of Labor; Dr. W. O. Thompson, president of Ohio State University, and Merle Crowell, editor of the American Magazine. Liska is the fifth high school student to win this honor in as many years. Honorable mention was given to the essays by Richard Arimizu, Hilo, Hawaii; H. Harold Kelley, 707 West Euclid Avenue, Pittsburg, Kansas; and Viola Greene, Willimantic, Connecticut, R. F. D. No. 1.

The prize winning essay follows:

### THE RELATION OF IMPROVED HIGHWAYS TO HOME LIFE.

BY JOHN LISKA

Isolation is the primary cause of the ignorance so evident in rural communities. Poor roads, more than anything else,

* The Secretary represents the Society on the Highway Education Board

have forced the farm home into a demoralizing isolation. The improvement of highways, making the consolidated school and social center possible, is injecting new life into homes formerly hopelessly isolated. Home life is broadened and enriched. Boys are willing to stay "down on the farm." Girls cease to envy their city cousins and to leave home for "the bright lights."

Just a few minutes of travel on a particular road leading out of the city of Wisconsin Rapids, will convince the most doubtful skeptic of the value of good roads and their influence upon home life. About two miles from the city this road branches. One branch is called "the left road"; the other "the right road." The left road is almost always in a deplorable condition; the right road is hard surfaced. The homes on the left road are dilapidated, the front yards scarcely recognizable among the tangle of broken machinery, old wire, and various other objects placed "out of the way." The land has been cropped till it is impossible for even quack grass to flourish. The stock, descendants of some of Grand-dad's scrubs, is now so degenerated that scarcely any characteristics of a high-producing, profitable animal are evident.

Can you expect the boy or girl to remain "down on the farm" under these conditions? Not one boy or girl living on this road has any education above the eighth grade, and very many have not even completed the eighth grade. These young people, many of them lying about their ages, have had to seek a "job" at the store, mill or factory, instead of completing their educations. Can home life be pleasant and happy where these conditions exist?

The road to the right leads through land slightly more fertile, but more fertile only as a result of better farm management. No farm home on this road, for a distance of twenty miles, is without at least one modern convenience. Several farms are equipped with every modern convenience, both in and out of the home.

The æsthetic influence a good road exerts is very evident. Often it stimulates latent self-respect into practical expression. These people are continually adding some improvement in an honest attempt to beautify their home surroundings. Through diversification and rotation of crops they have succeeded in bringing their land to a high degree of fertility, resulting in a more stable income each year. They are sending their children to high schools, agricultural schools and

universities. A better education is teaching these children to realize the value of a true home.

Before the right road was improved, conditions were alike on both branches. The improved highway alone made diversified farming profitable, made a better education possible and better homes a reality.

On the left road the average farmer has, in a large measure, lost his self-respect and has allowed his home to fall below the standard and has failed to keep in stride with the times. He is considered inferior to city people. Farmers, such as those on the right road, are again placing the farm home upon the pinnacle where it should rest, "The True Home of Man."

How necessary to that home is a good road! What a relief it must have been to those simple folk in Whittier's "Snow Bound" to have the road opened and the floundering carrier bring the village paper to the door!

The left road may be compared to the snow-bound road, impeding progress, forcing isolation. The right road may be compared to the opened road, offering new opportunities, new possibilities and new happiness.

The right road is, in the true sense of the word, the "right road." We must build more of them. Until this is accomplished, home life in isolated sections will, in the future, simply exist; but when all roads are right roads, these same communities, these same homes, will live.

## BURLINGTON MEETING OF THE NEW ENGLAND SECTION.

The fall meeting of the New England Section was held at the University of Vermont, Burlington, Saturday, October 11, 1924. Located on Lake Champlain in the heart of the Green Mountains, Burlington is a city of much interest and unique beauty. The possibilities presented for attendance by auto were taken advantage of by a considerable number of the members and the attendance of ladies was exceptionally large.

The morning session was called to order on the roof garden of Hotel Vermont at 10:30 A.M. by the Chairman, Dean Anthony of Tufts. After the reading and acceptance of the minutes of the preceding meeting and the customary reading of the by-laws the Chairman introduced the topic of the meeting *The Human Side of Education.*

Professor H. P. Hammond, Associate Director of the Board of Investigation and Coördination of the Society for the Promotion of Engineering Education, gave a very interesting address dealing with the activities and plans of the Board. After an animated discussion an adjournment was taken for lunch.

The meeting was again called to order at 1:30 P.M. Professor W. J. Creamer, of Maine, gave a report upon the Personnel System which is in operation at that institution. Dean Boardman spoke upon the activities of Freshman Week at Maine. Dean Kenerson explained the system of Pre-Registration in use at Brown and Professor Seavey gave a description of the introduction of the system of Pre-Registration at Tufts. The remainder of the time until 3:30 was taken up in discussions of the foregoing subjects by various members. An adjournment was then taken to automobiles for a visit about the College campus and points of interest in the city finally arriving about 6:00 o'clock at the Champlain Club which is beautifully located about nine miles away upon the

shore of the Lake where the members and ladies were the guests of the University. A bountiful repast was served at 6:30 after which followed a round-table discussion in front of a blazing fire.

The features of the evening were as follows: An Address of Welcome was given by Dean Votey of Vermont and was responded to by Chairman Anthony. President Little of Maine, Professor Clifford of Harvard and Professor Scott of Yale gave addresses which were listened to with much interest. Professor Clifford offered the following resolution which was unanimously passed by a rising vote:

*Resolved:* That the New England Section of the Society for the Promotion of Engineering Education hereby unanimously expresses its appreciation of the entertainment and many courtesies which have been extended by the University of Vermont during this, the eighth meeting of the Section. It especially desires to make known its appreciation of the work of the various committees and to make particular mention of the kind entertainment furnished to the ladies.

Fifty-nine members attended the morning and afternoon sessions and eighty-eight were in attendance at the banquet, including twenty-nine ladies. The following institutions were represented: Brown University, Brooklyn Polytechnic Institute, Franklin Union, Wentworth Institute, Harvard, University of Maine, Massachusetts Institute of Technology, Northeastern University, University of New Hampshire, Norwich University, Tufts College, Yale University and University of Vermont.

H. S. BOARDMAN,
*Secretary.*

## NECROLOGY.

**William Henry Emerson** was born at Tunnel Hill, Georgia, in June 1860. He graduated from the United States Naval Academy in 1880; was Midshipman from 1880 to 1882, and Ensign 1882 to 1884. He then resigned from the Navy to pursue special studies at the Johns Hopkins University, from which institution he received the degree of Ph.D. in 1886, having specialized in chemistry. In the same year he accepted the appointment to the professorship of chemistry at the South Carolina Military Academy, Charleston, S. C., which position he resigned in 1888 to become Professor of Chemistry at the Georgia School of Technology, just then in process of organization. Here he remained until the day of his death, November 13, 1924—a period of thirty-six years. During this time he saw the institution grow from the experimental stage into one of the leading engineering and technical schools of the country. To him especially is due credit for the maintenance of high standards of scholarship, which have characterized the work of Georgia Tech. By temperament and training he was especially equipped to do research work on problems in his chosen field, and longed to do so, but with characteristic spirit he sacrificed opportunity which those who knew him believe would have placed his name high in scientific achievement, in order to carry on the heavy duties developing upon the head of a department of a growing institution, and the additional great responsibility of the deanship, which he assumed in 1910.

Dean Emerson was awarded the degree of Sc.D. by the University of Georgia in 1912. He was a member of the American Chemistry Society; Phi Kappa Phi (Honor Society); Georgia Academy of Sciences; Alpha Tau Omega Fraternity; and Society for Promotion of Engineering Education.

He published papers covering investigations he had made in the Oxidation of Mesitylene; the Composition of Cotton Seed Oil; and also upon the Marbles, Coal and Corundum of Georgia.

## BOOK REVIEW.

*Practical Calculus for Home Study.* By C. I. PALMER. McGraw-Hill Book Company, Inc. xx + 443 pages, 4½ x7¾. 184 diagrams.

To quote the author, "It aims to give the man with limited mathematical training the ability to make use of the calculus as he needs it in his work," and "The subject of calculus cannot be made *easy* but it can be made *plain.*"

The explanations are full and adequate. Fundamental principles are stressed through repetition and applications. Illustrations and problems are numerous, practical, and well selected. The differential receives far more than the usual attention in the hope of fostering visualization. Rigor and comprehensiveness are not unduly sacrificed. The selection of the subject matter and the order of its arrangement do not differ greatly from that of the standard texts in the same subject. Integration is taken up first in Chapter IX following one hundred pages devoted to the differentiation of algebraic functions with applications to algebra, geometry, and physics. Chapter XXIII, the last, contains a brief review of analytic geometry and eight tables. The latter include the following: Values of $e^x$ and $e^{-x}$, Common Logarithms, and Trigonometric Functions Answers are bound with the text.

The Book should prove satisfactory as a class-room text as well as for "Home Study." The author has displayed a knowledge of practical psychology both in his presentation of the subject and in the title he has chosen for the text: the word "Practical" appealing to the student and the words "for Home Study" to the instructor.

K. D. S.

## NEW MEMBERS.

G. C. SHAAD,

*Chairman*, Membership Committee.

*District No. 2.*

ALVORD, HENRY B., Professor of Civil Engineering, Northeastern University, Boston, Mass.

FERRETTI, ALFRED J., Assistant Professor of Mechanical Engineering, Northeastern Univ., Boston, Mass.

BROCK, JOHN A. VAN den, Associate Professor of Engineering Mechanics, Univ. of Mich. Ann Arbor, Mich.

HITCHCOCK, MARY ALICE, Instructor in English, The Ohio State University, Columbus, O.

REEN, CALVIN G., Assistant Professor of Civil Engineering, Gettysburg College, Gettysburg, Pa.

SHIELDS, NESBITT C., Instructor in Engineering English, The Ohio State University, Columbus, O.

SIEG, LEE P., Professor and Head, Dept. of Physics, University of Pittsburgh, Pittsburgh, Pa.

TERWILLIGER, CHARLES Van Orden, Assistant Professor, The Ohio State University, Columbus, O.

*District No. 3.*

GREAVES-WALKER, ARTHUR F., Professor of Ceramic Engineering, N. C. State College of A. & E., Raleigh, N. C.

HINKLE, LAWRENCE E., Professor of Modern Languages, N. C. State College of A. & E., Raleigh, N. C.

KOENIG, LLOYD R., Instructor in Mechanical Engineering, Washington University, St. Louis, Mo.

*District No. 4.*

CARTER, HAROLD S., Assistant Professor of Civil Engineering, S. D. State College, Brookings, S. D.

EICHENBERGER, WALTER G., Instructor in Engineering Drawing, University of Illinois, Urbana, Ill.

JENKINS, FRED R., Manager and Secretary, Chicago Central Station Institute, 72 W. Adam St., Chicago Ill.

LINDECKER, JOSEPH B., Instructor in Machine Design Dept. Purdue University, LaFayette, Ind.

## NEW MEMBERS.

McKee, James H., Assistant Professor of English, Purdue University, LaFayette, Ind.

Pefper Harry C., Head, Chemical Engineering Dept., Purdue University, LaFayette, Ind.

*District No. 5.*

Maverick, Lewis A., Recorder, University of California, Southern Branch, Los Angeles, Calif.

Witzel, Earl R., Instructor in Electrical and Mechanical Engineering, University of Wyoming, Laramie, Wyo.

South Dakota State College of Agriculture and Mechanic Arts, Brookings, S. D.